

FIG. 1A
PRIOR ART

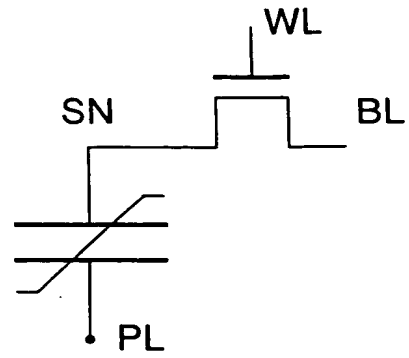


FIG. 1B
PRIOR ART

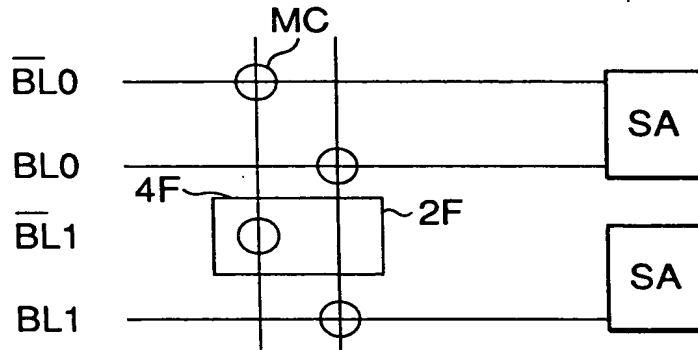


FIG. 1C
PRIOR ART

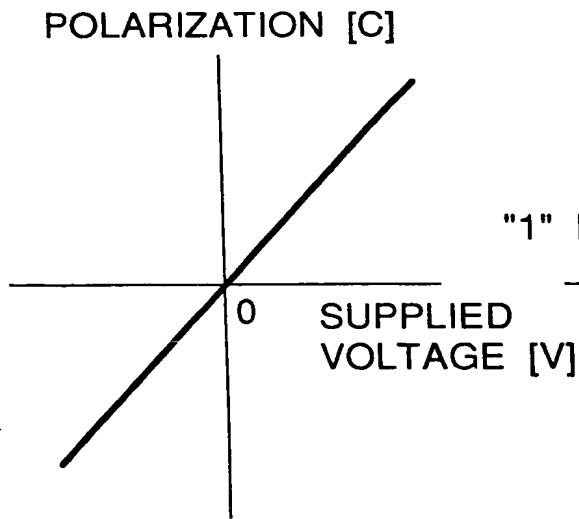


FIG. 2A
PRIOR ART

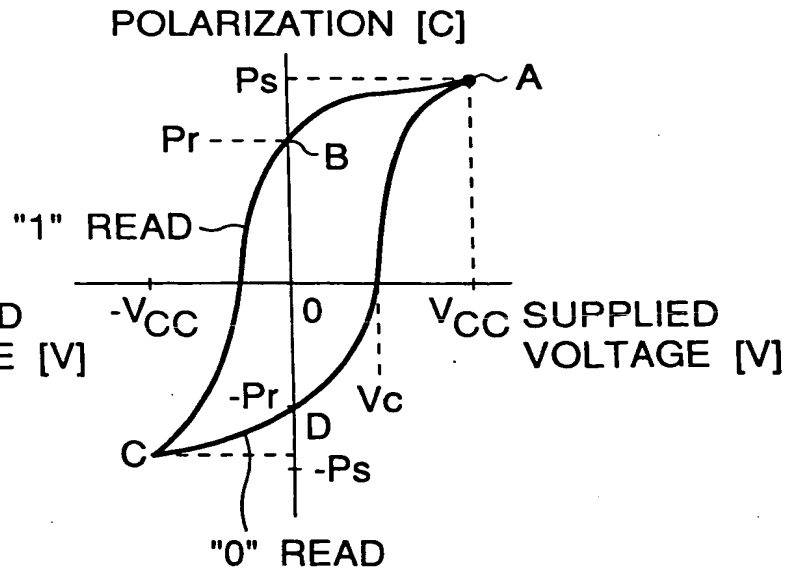


FIG. 2B
PRIOR ART

FIG. 3A
PRIOR ART

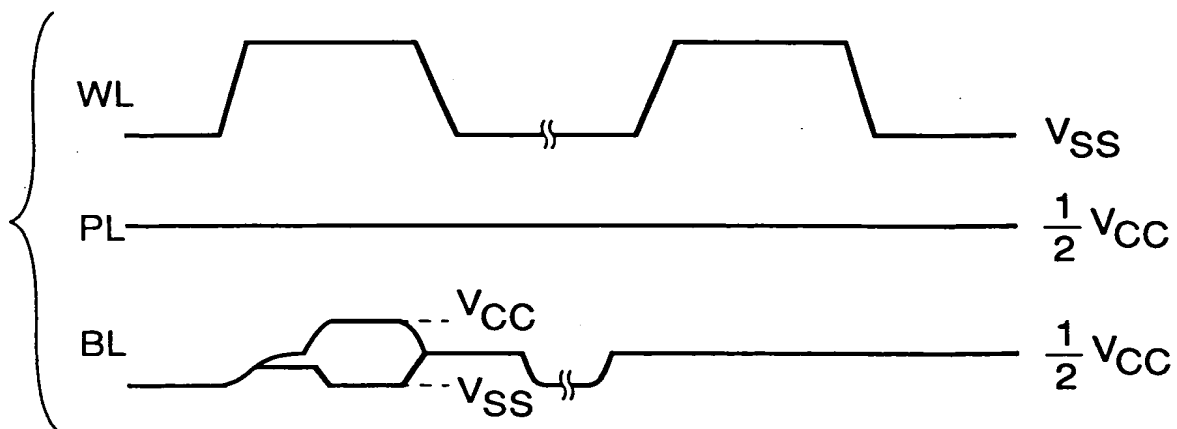
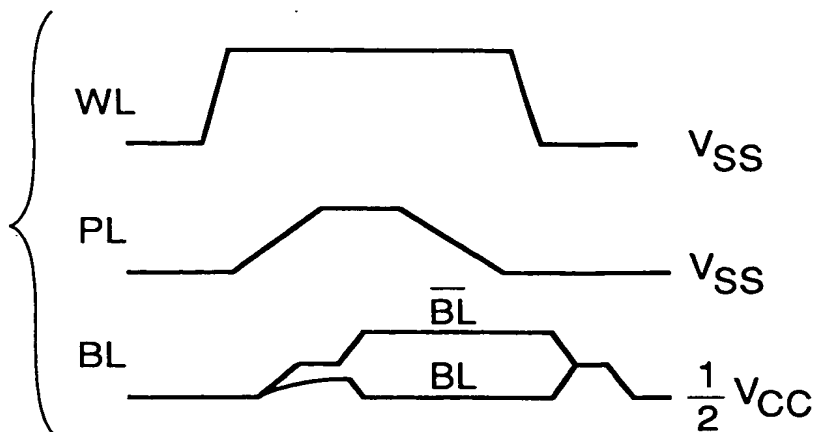


FIG. 3B
PRIOR ART

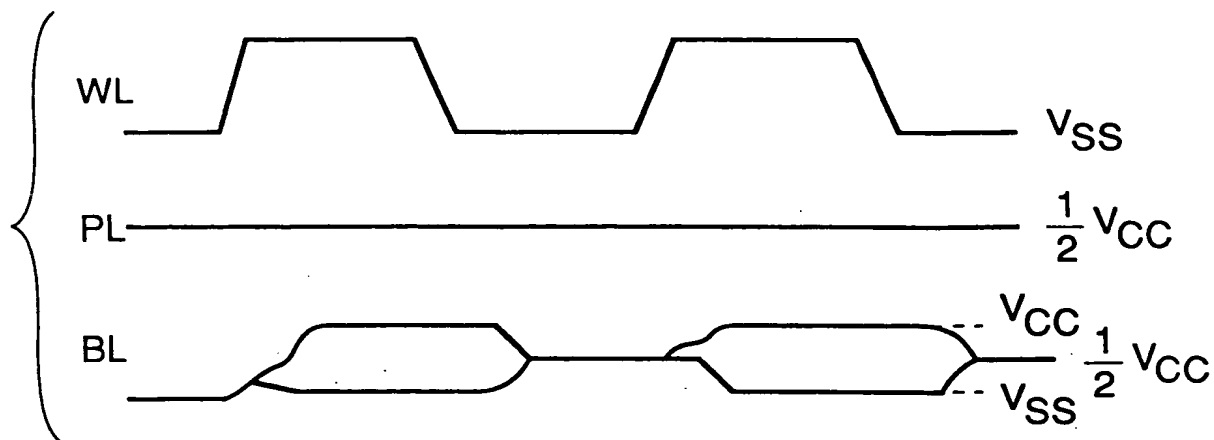


FIG. 3C
PRIOR ART

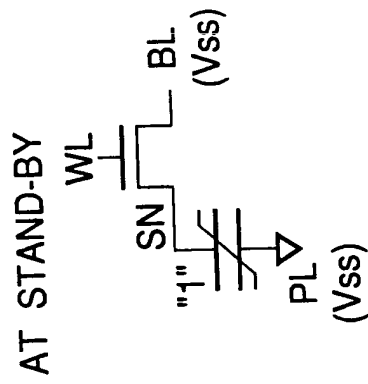


FIG. 4A PRIOR ART

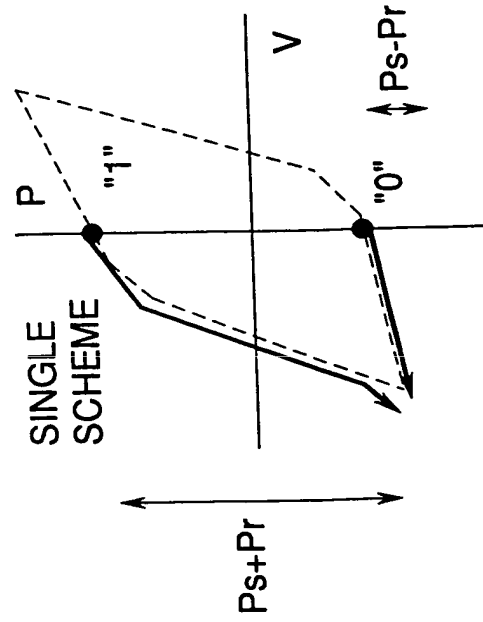
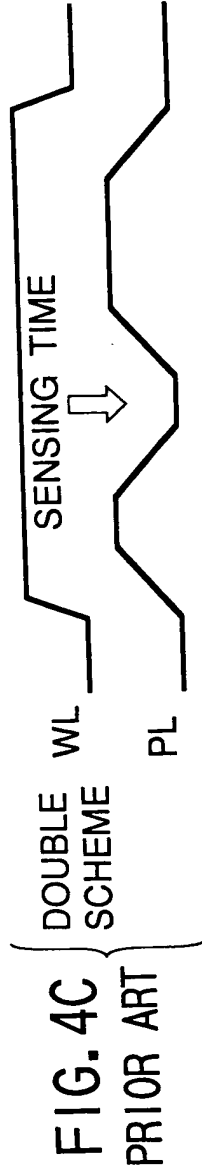
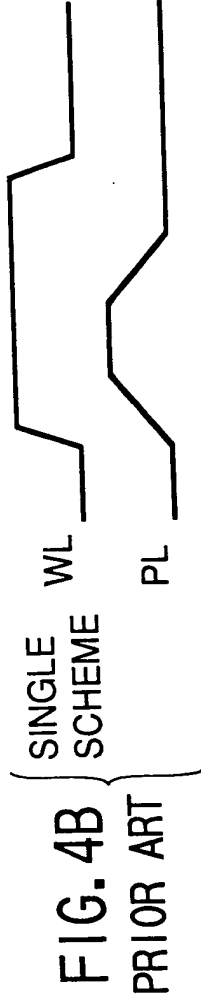


FIG. 4D PRIOR ART

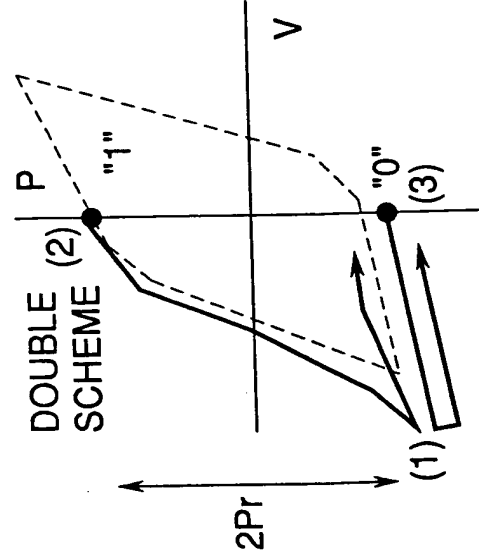


FIG. 4E PRIOR ART

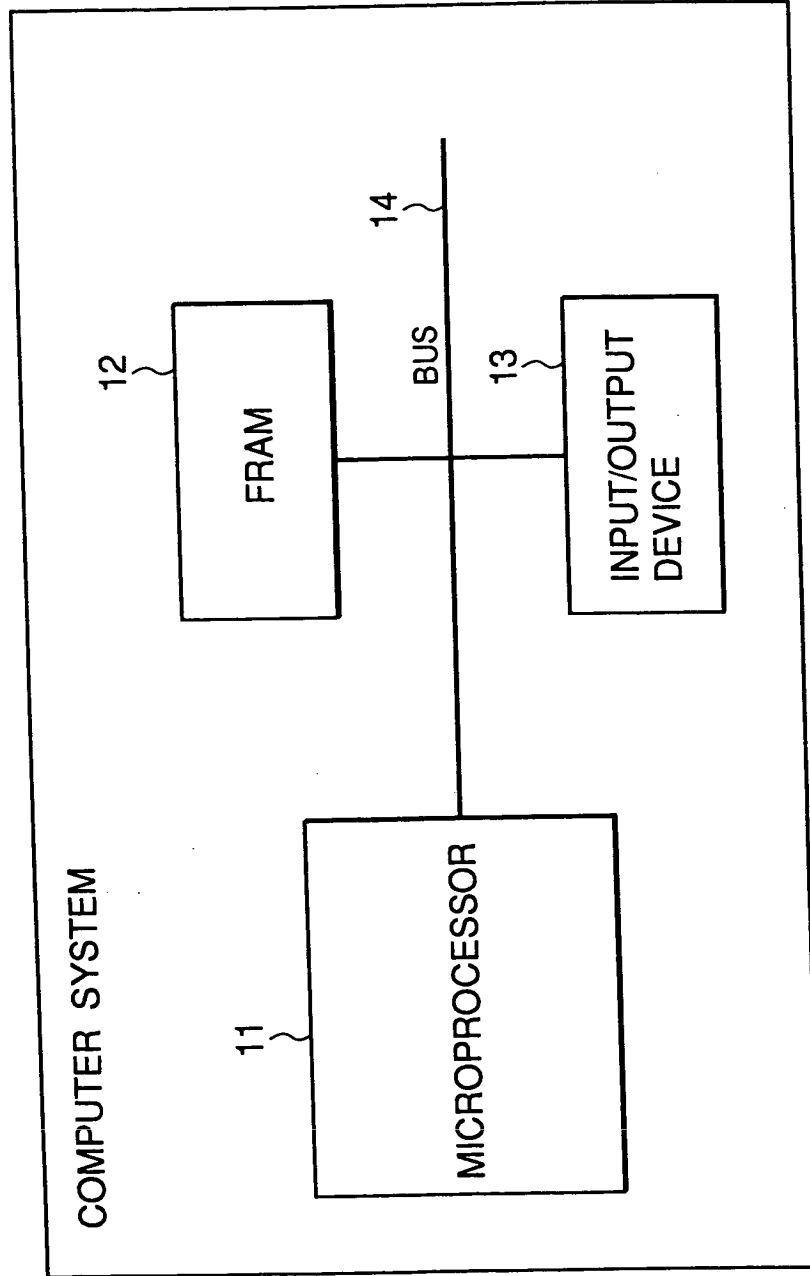
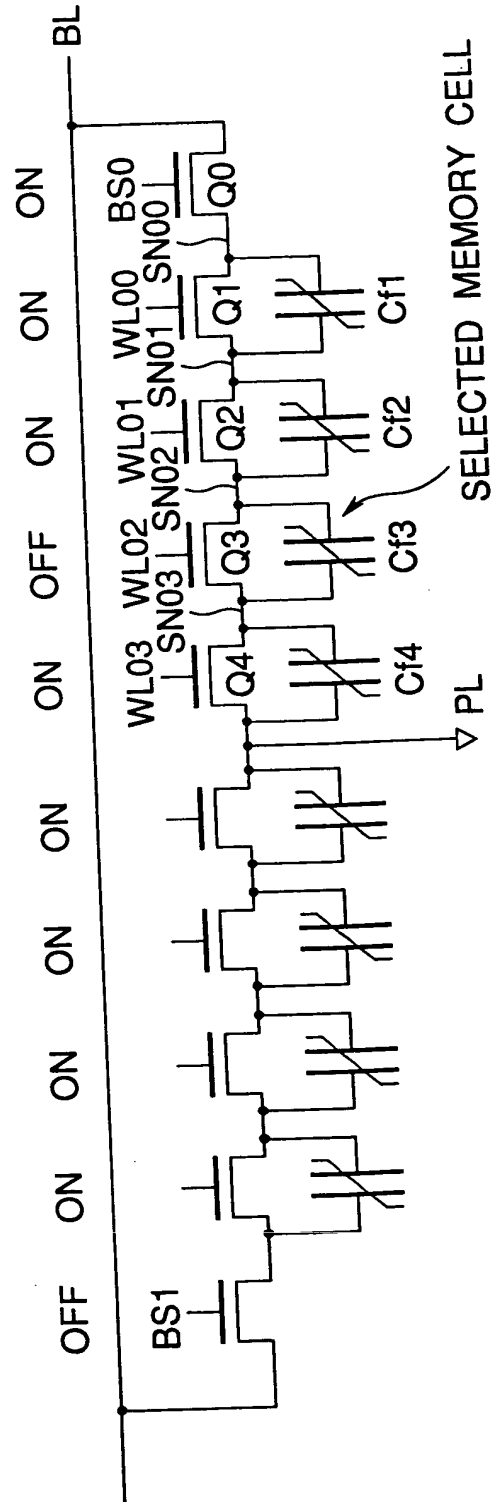


FIG. 5



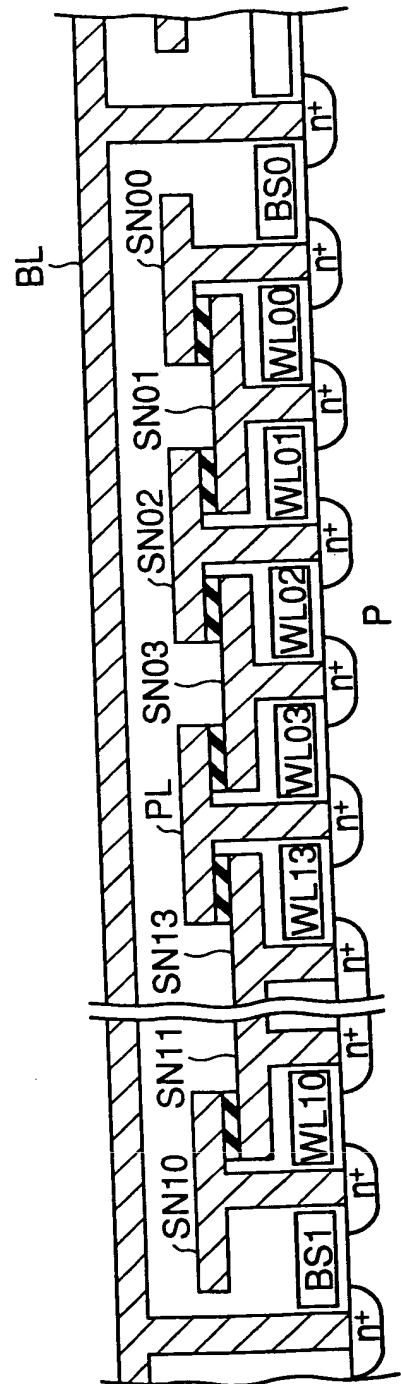
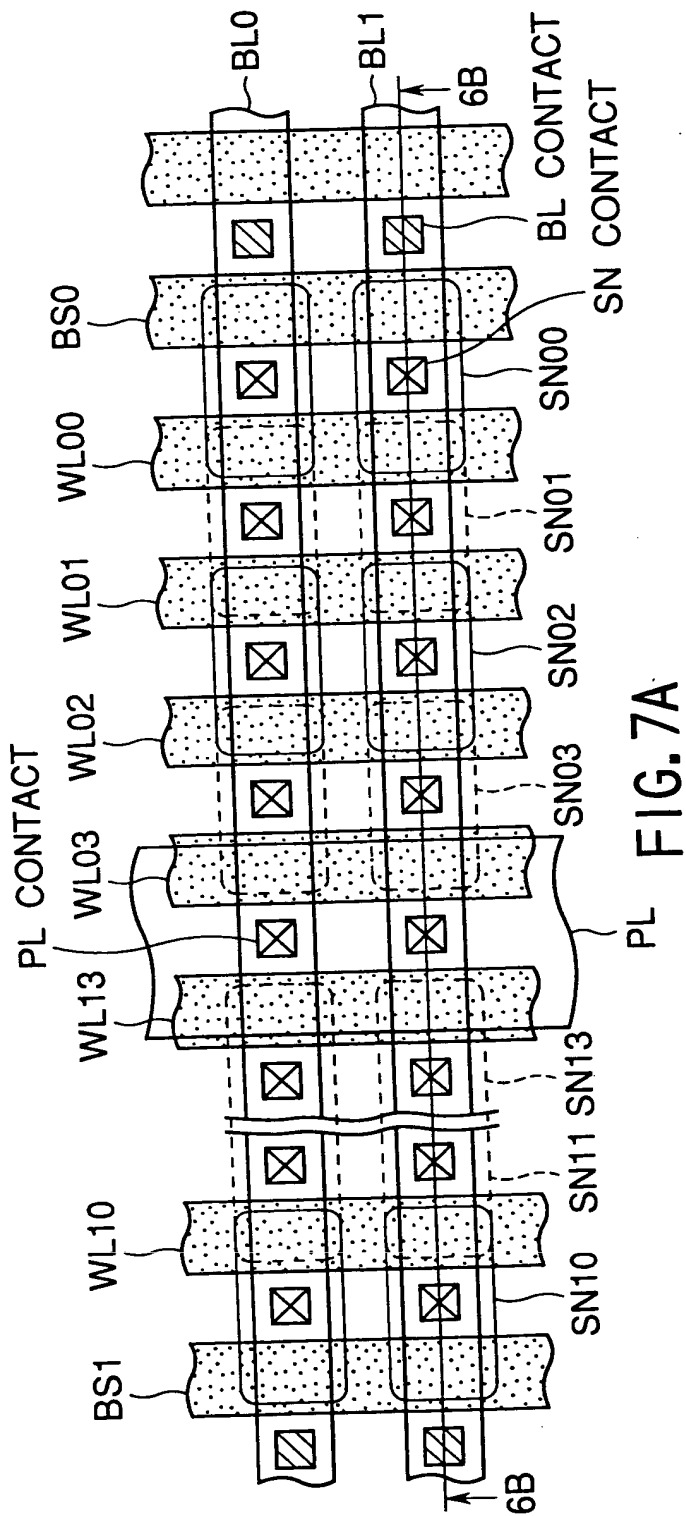


FIG. 7B

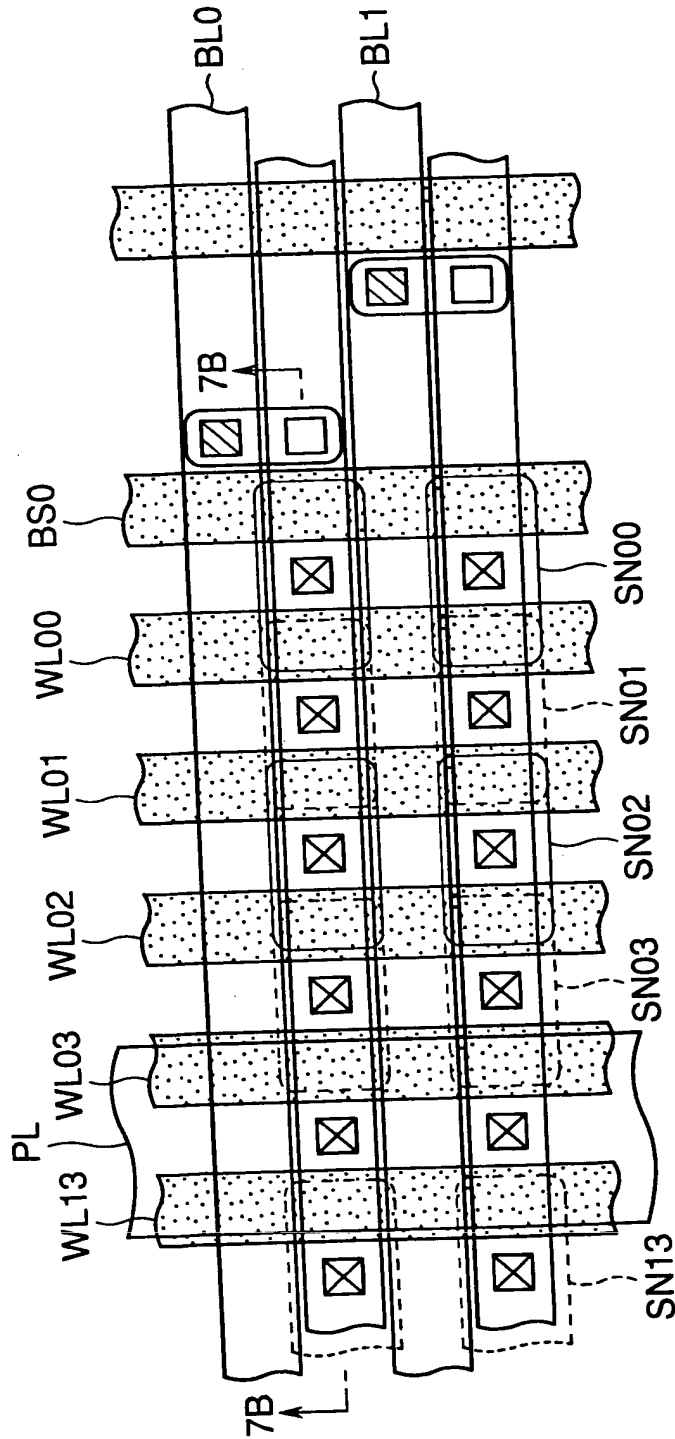


FIG. 8A

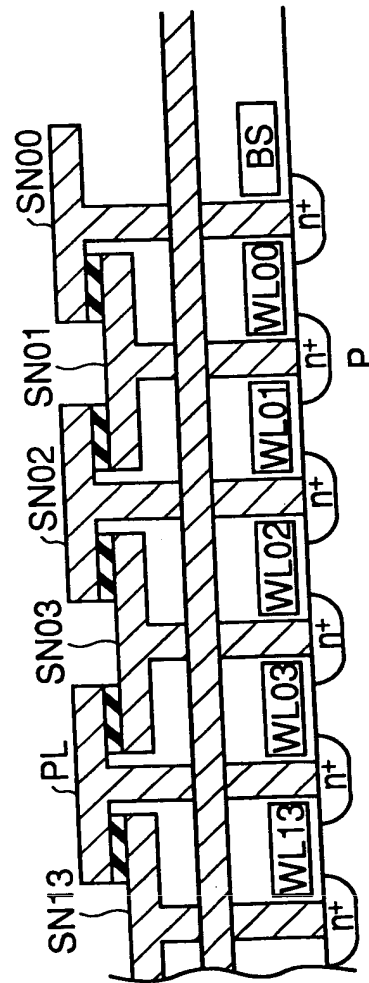


FIG. 8B

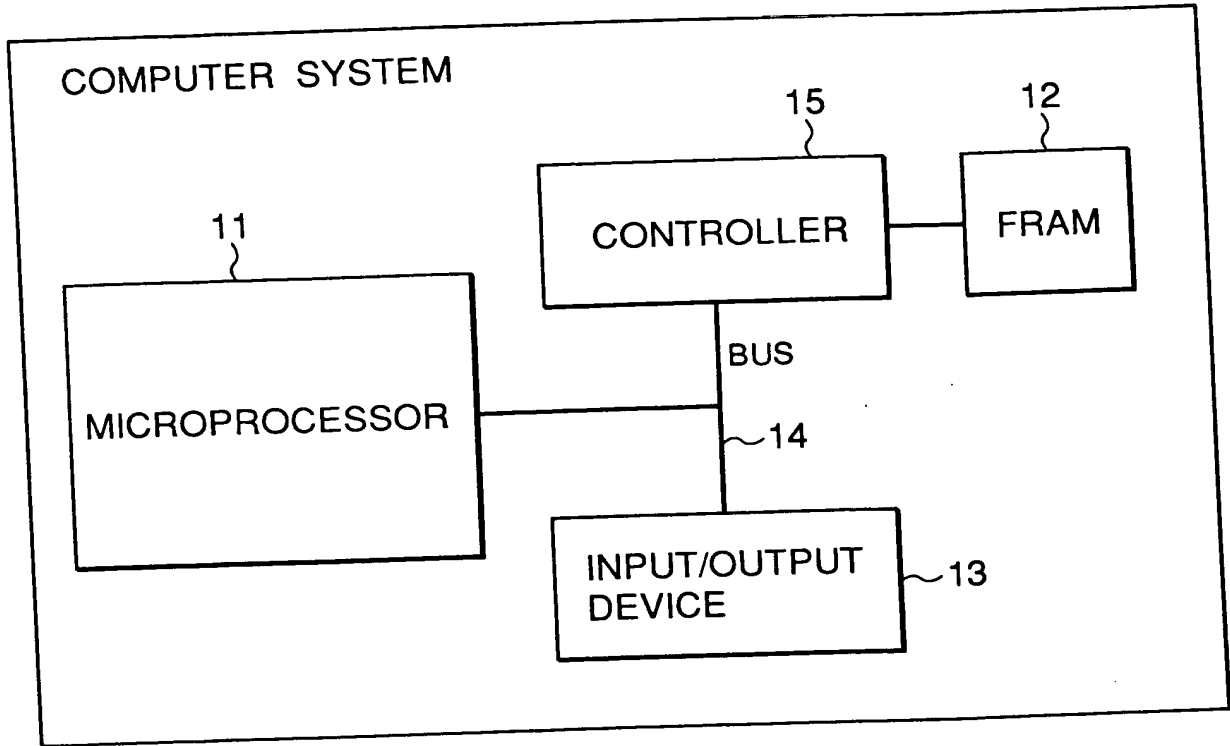


FIG. 9

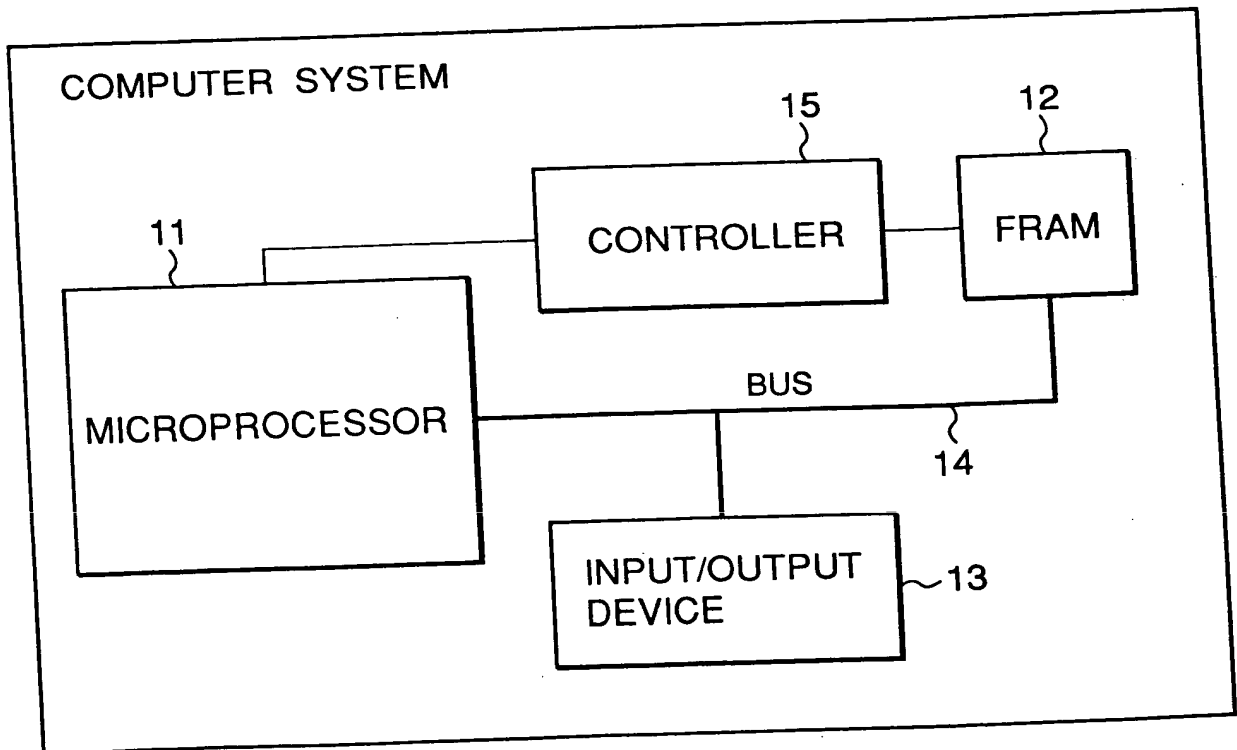


FIG. 10

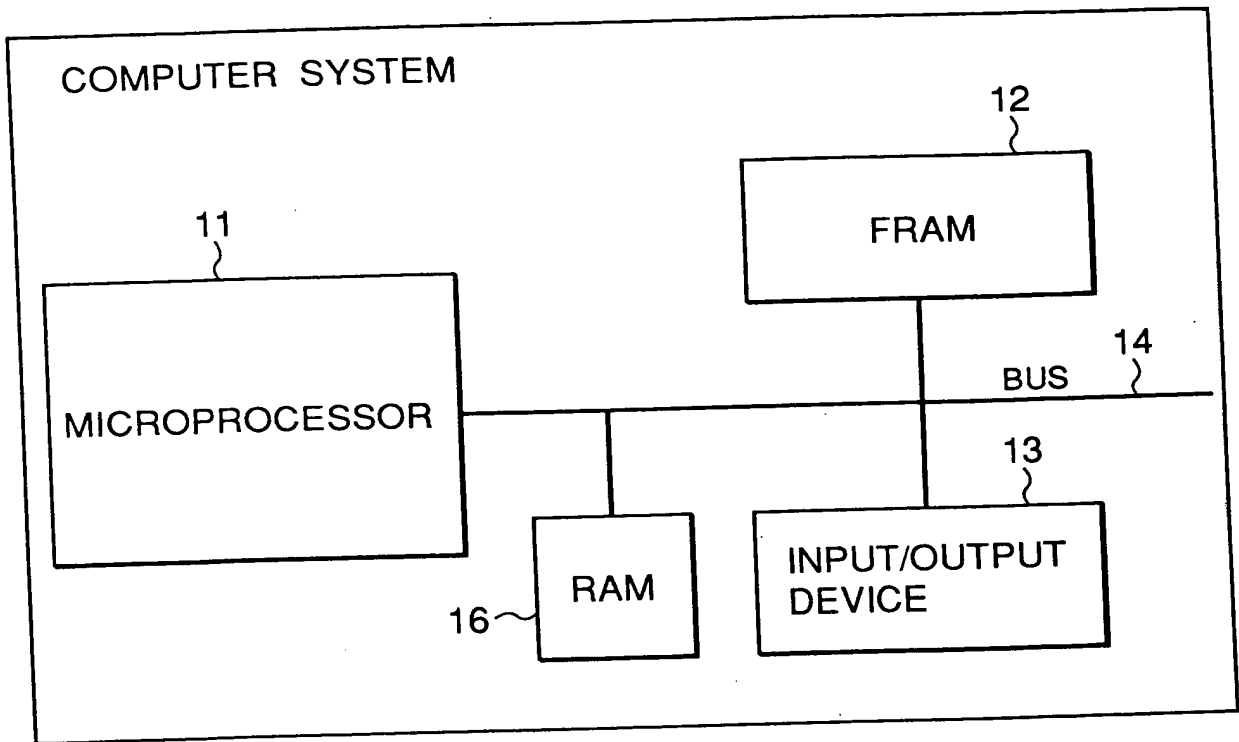


FIG. 11

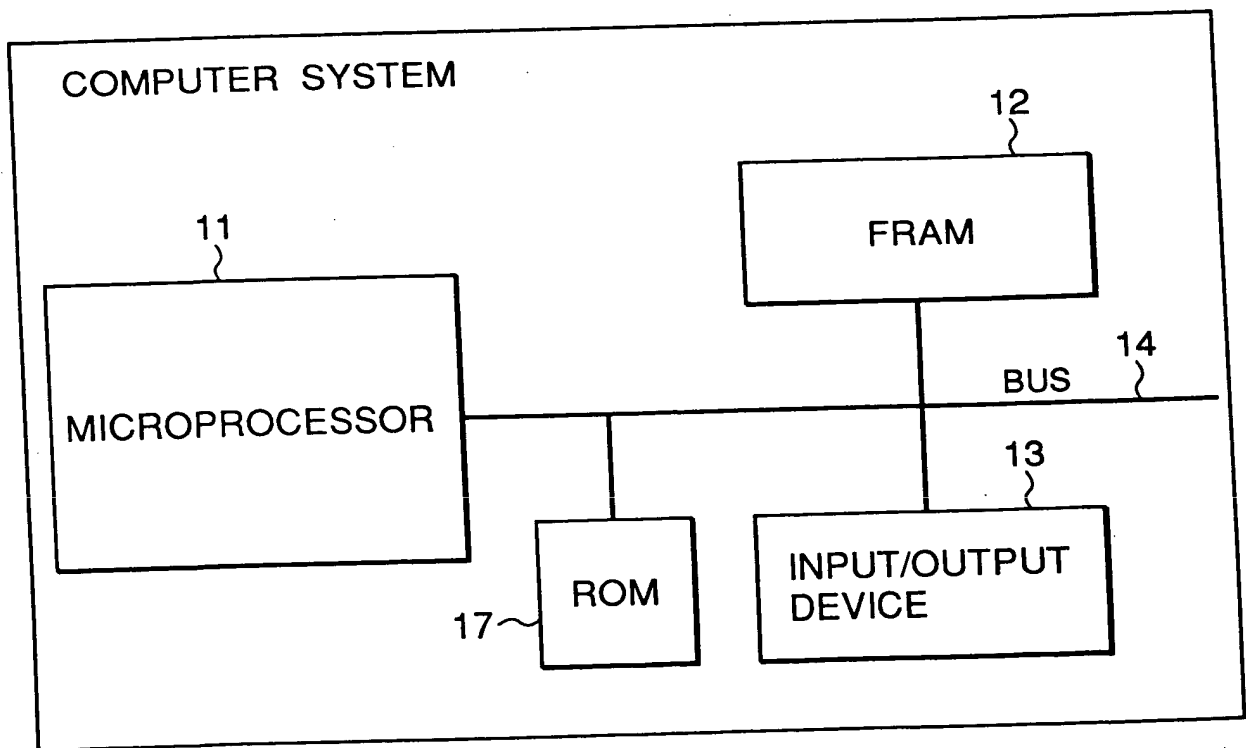


FIG. 12

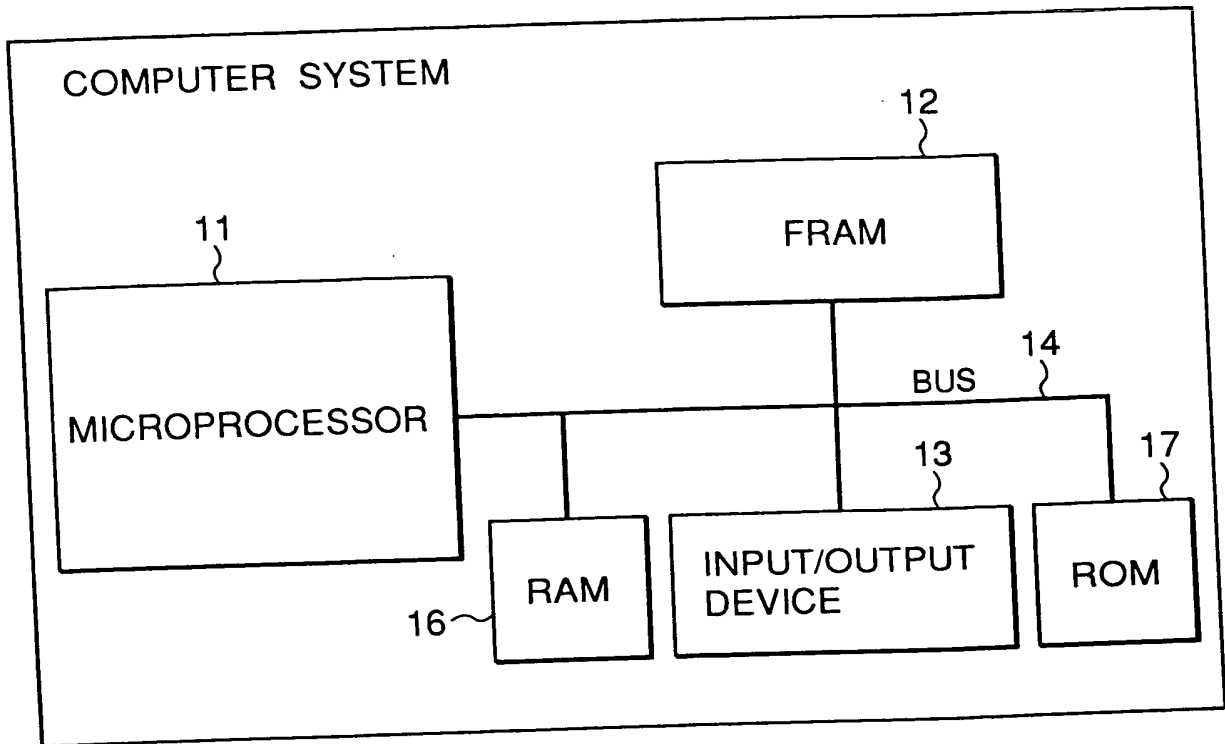


FIG. 13

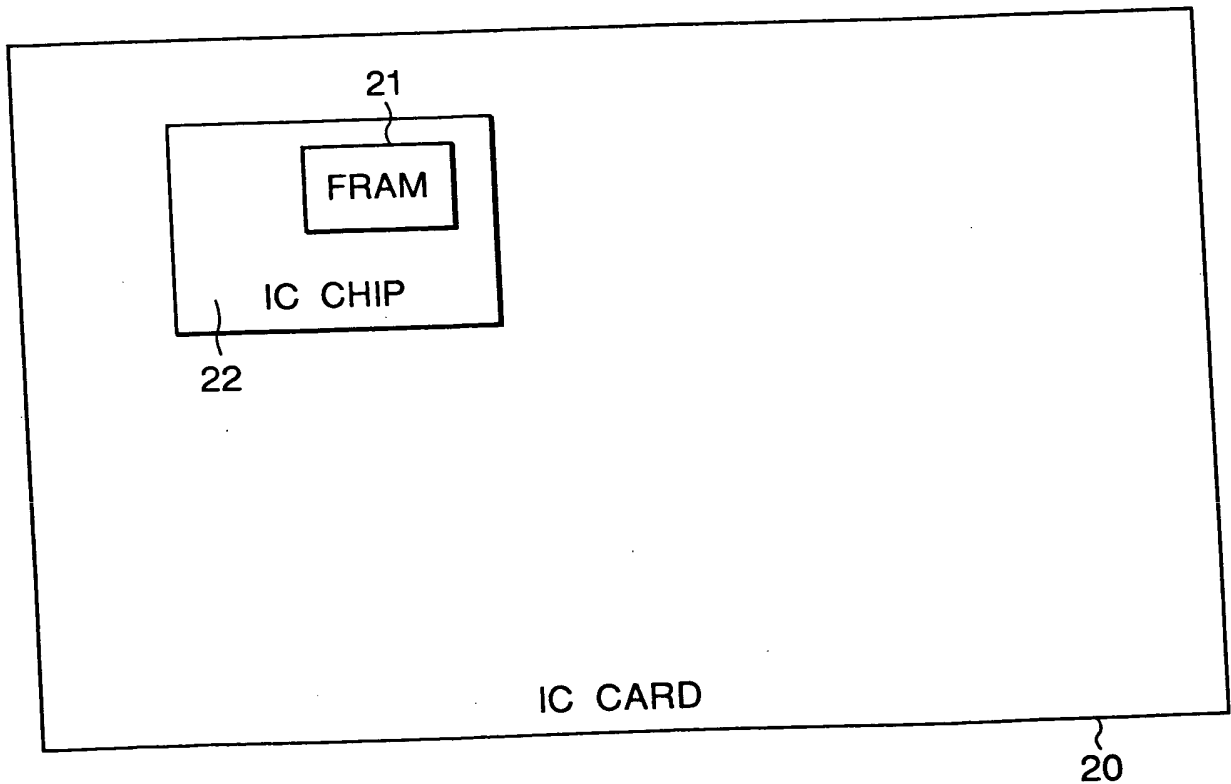
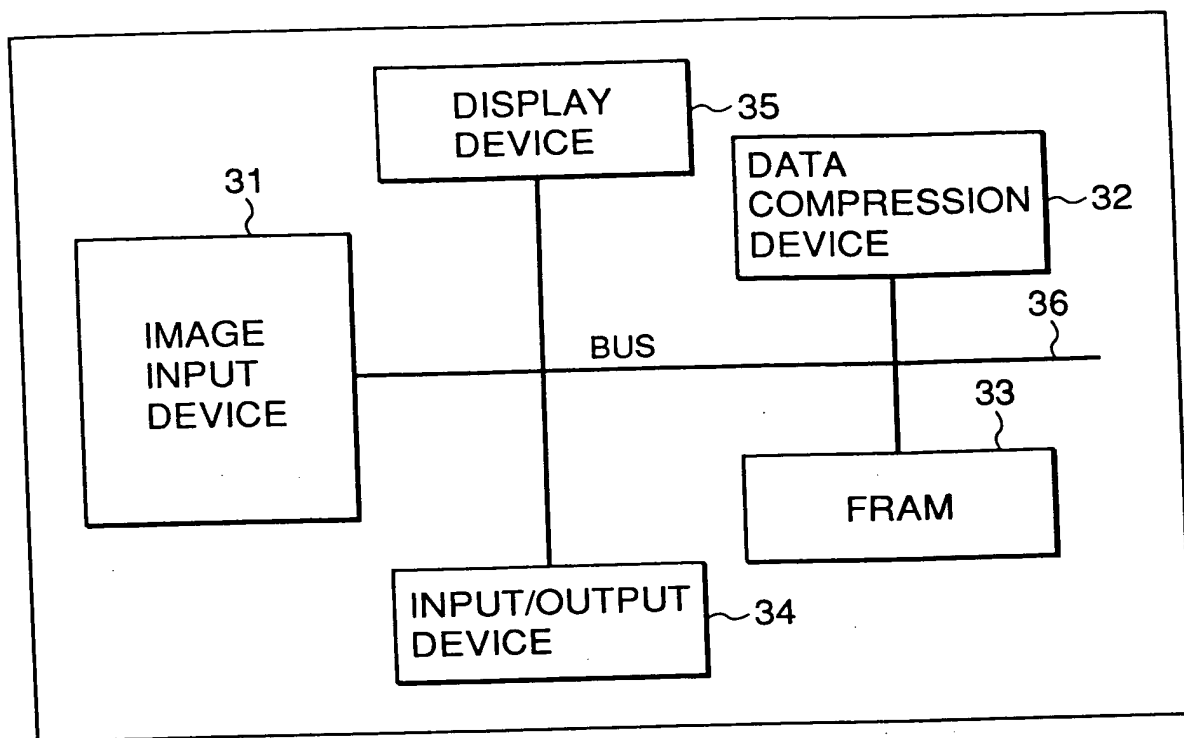


FIG. 14



DIGITAL IMAGE INPUT DEVICE

FIG. 15

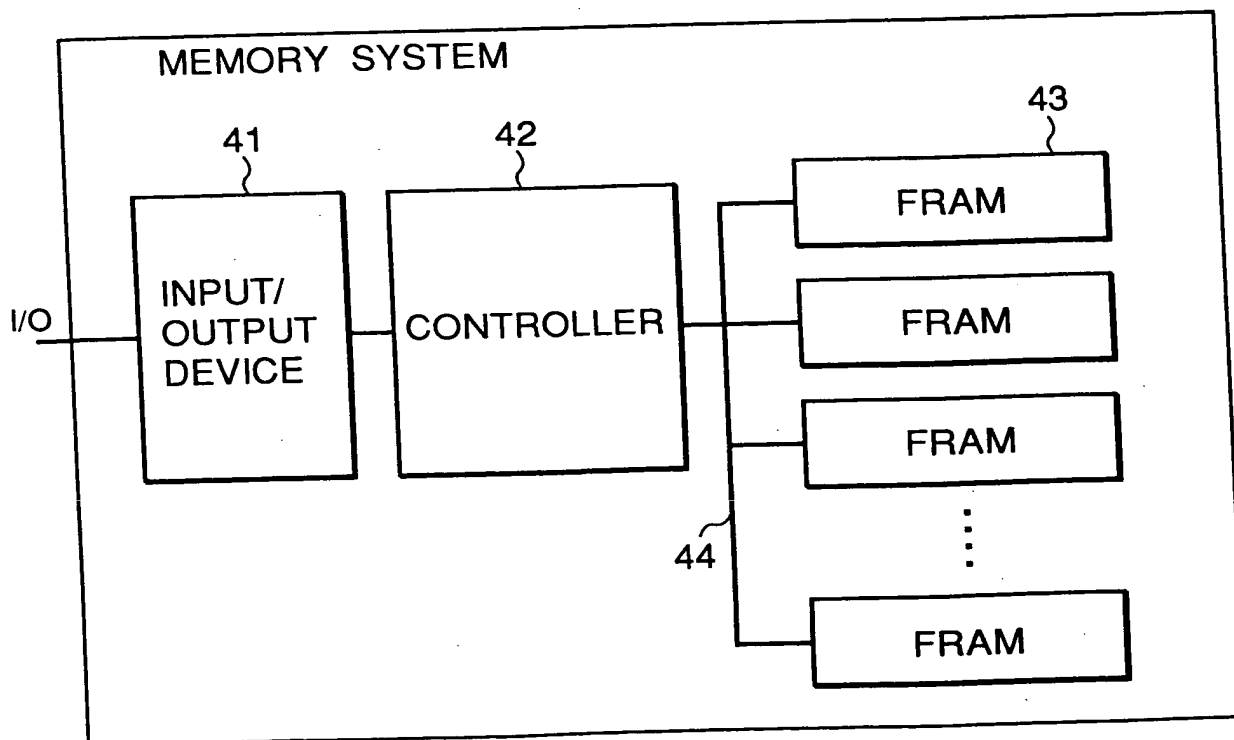


FIG. 16

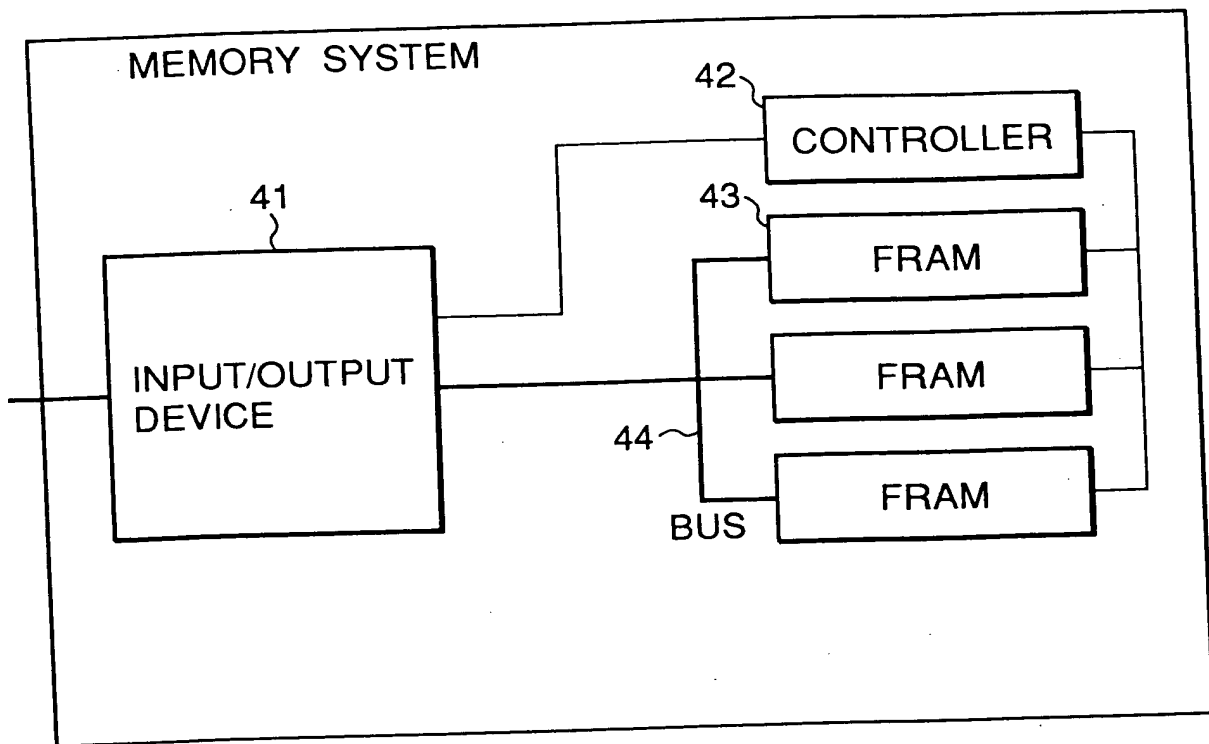


FIG. 17

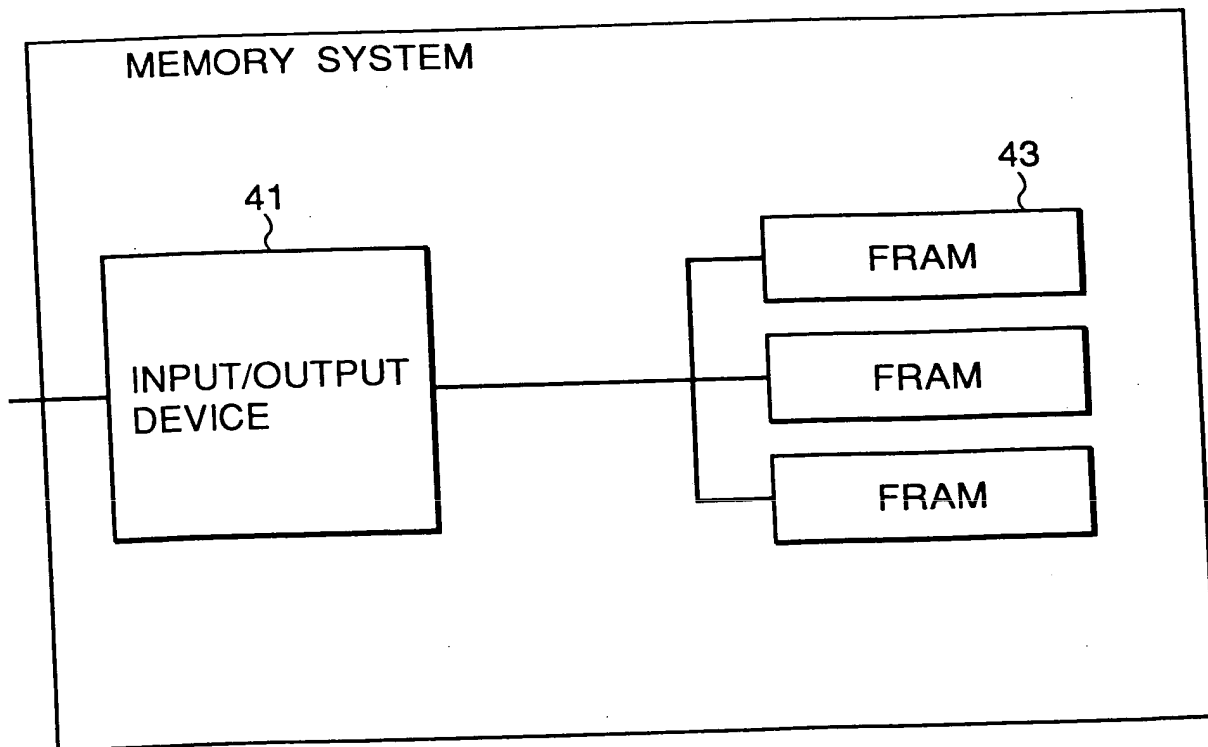


FIG. 18

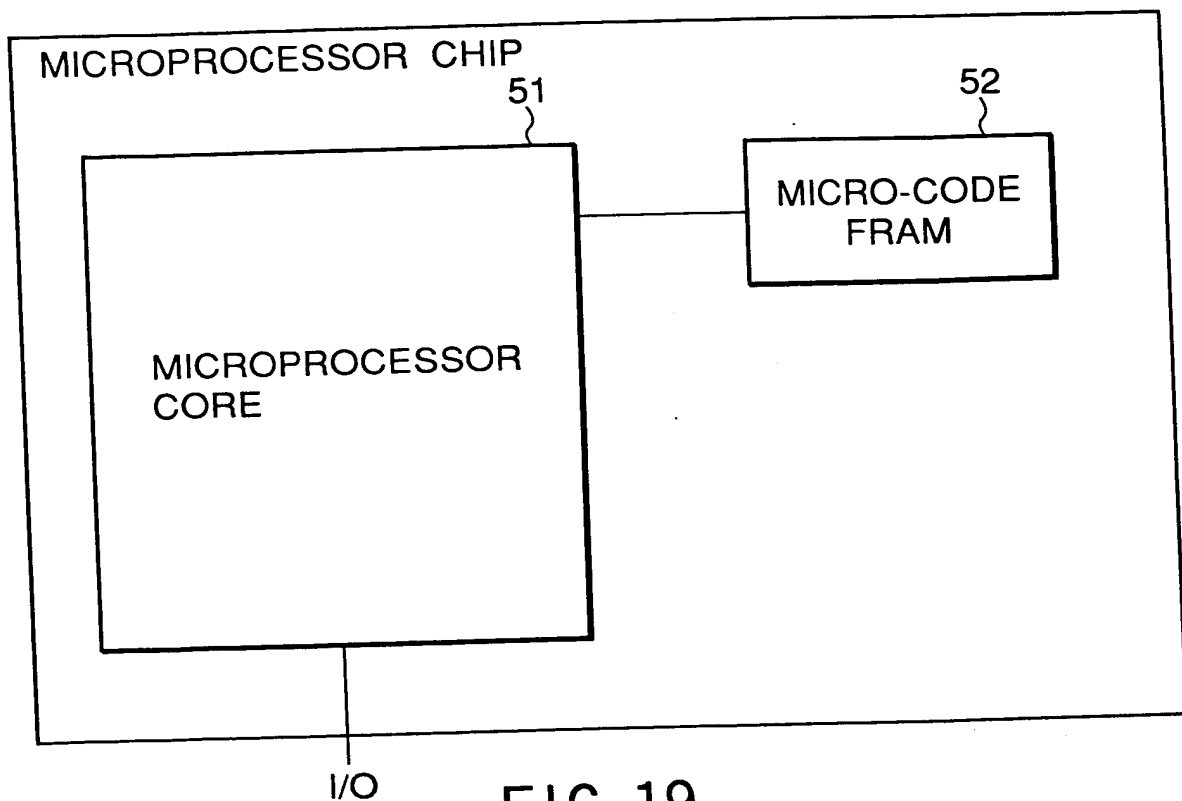


FIG. 19

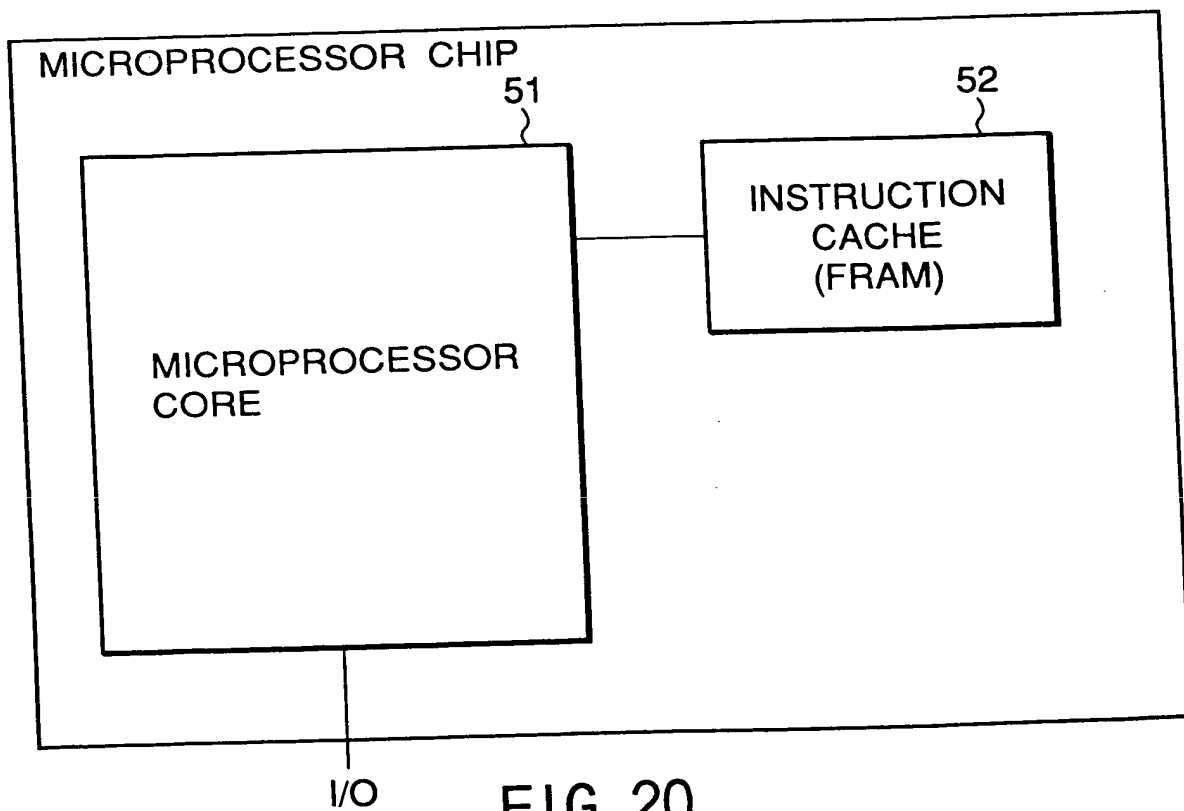


FIG. 20

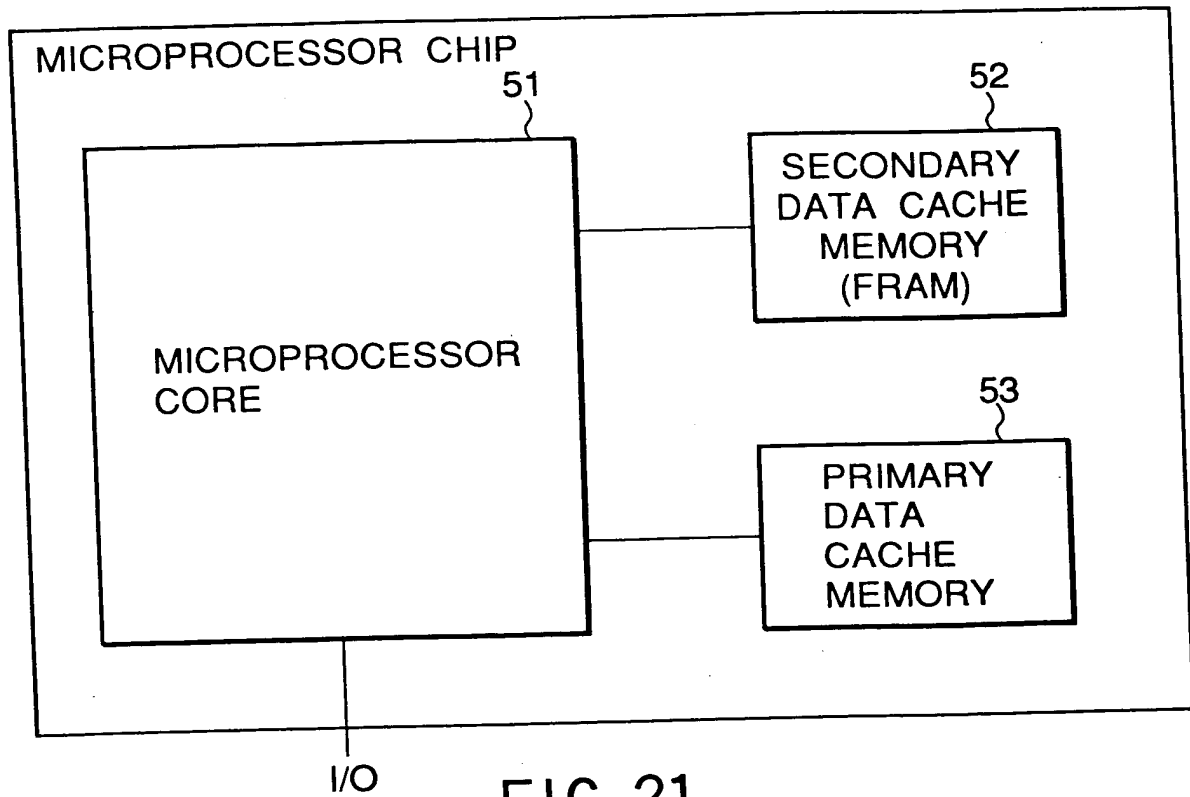


FIG. 21

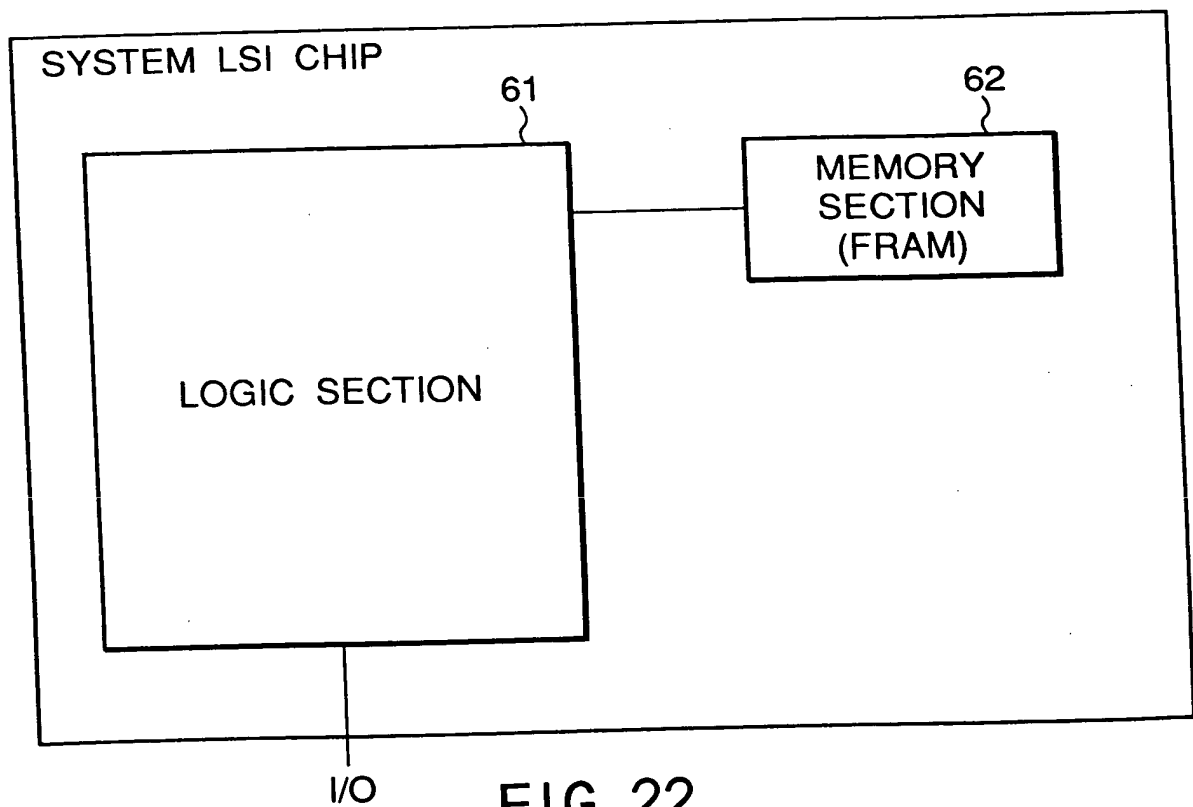


FIG. 22

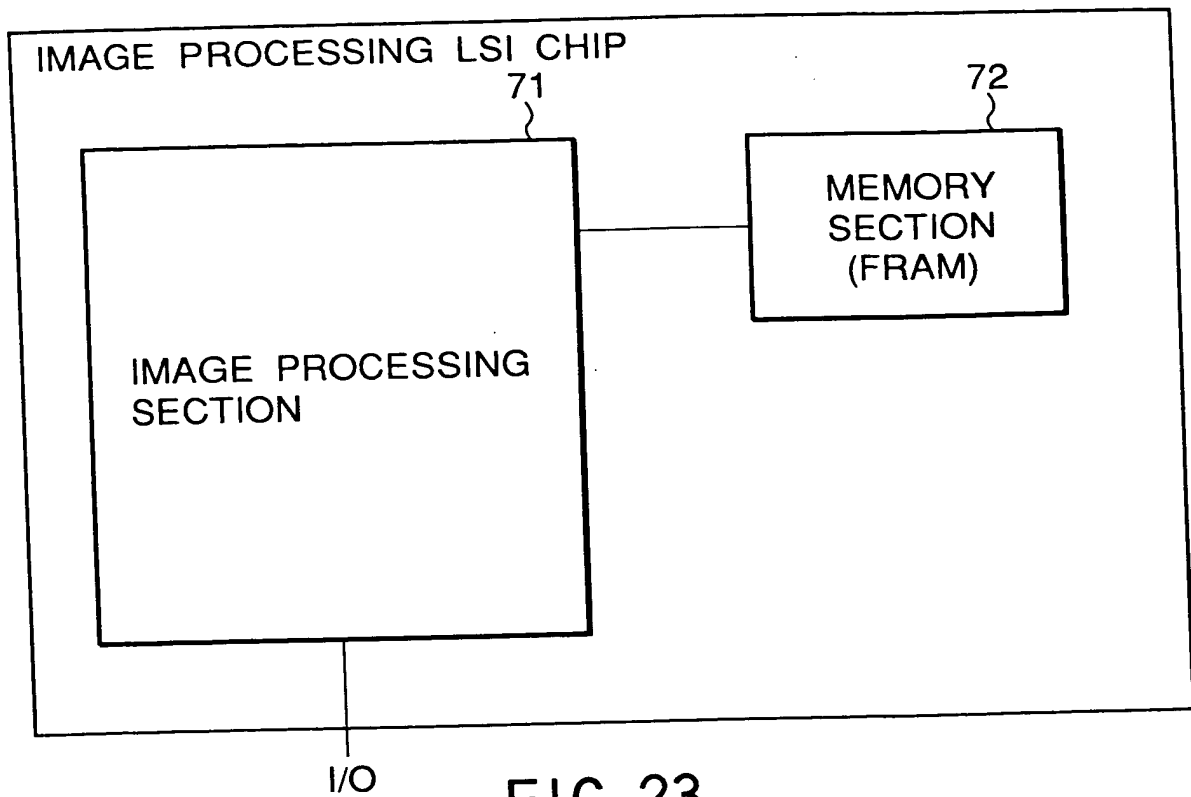


FIG. 23

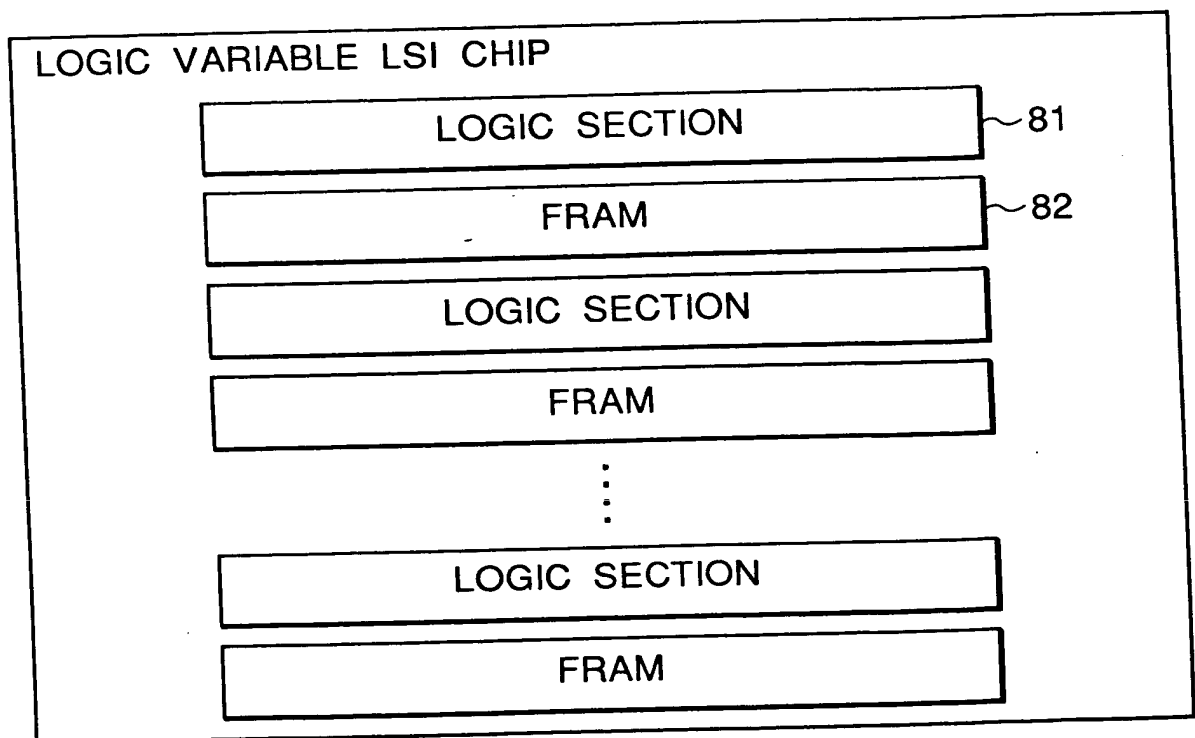


FIG. 24

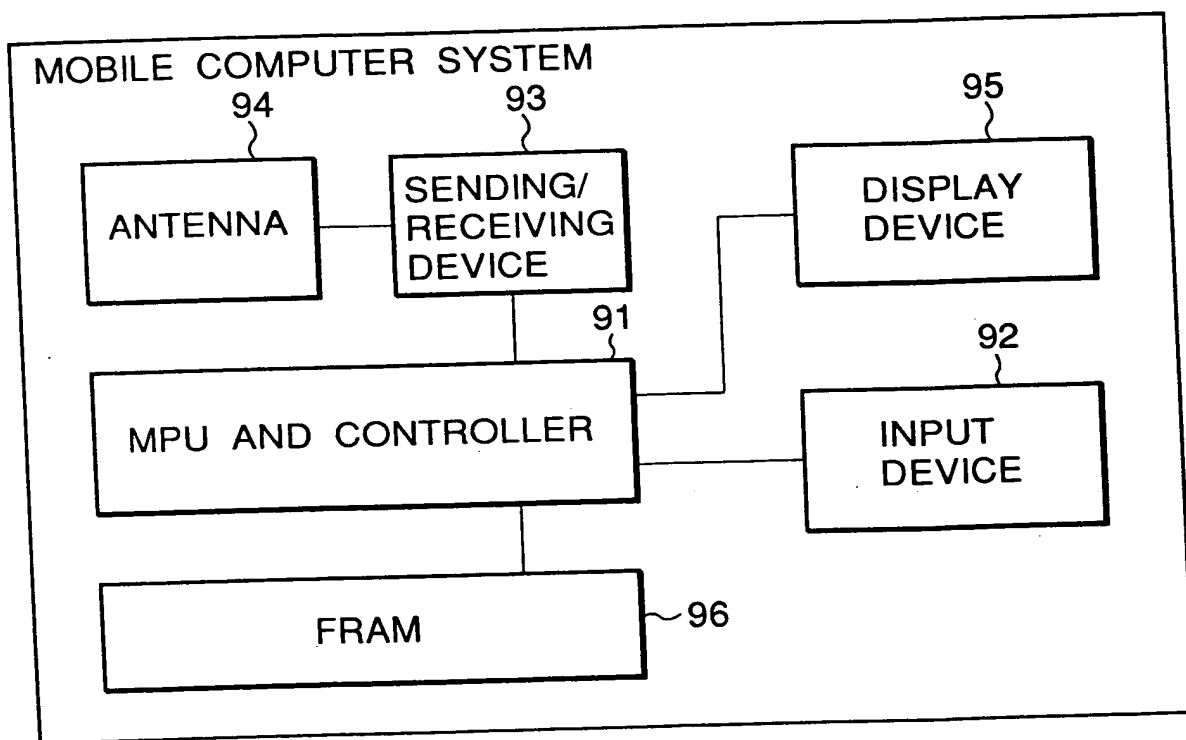
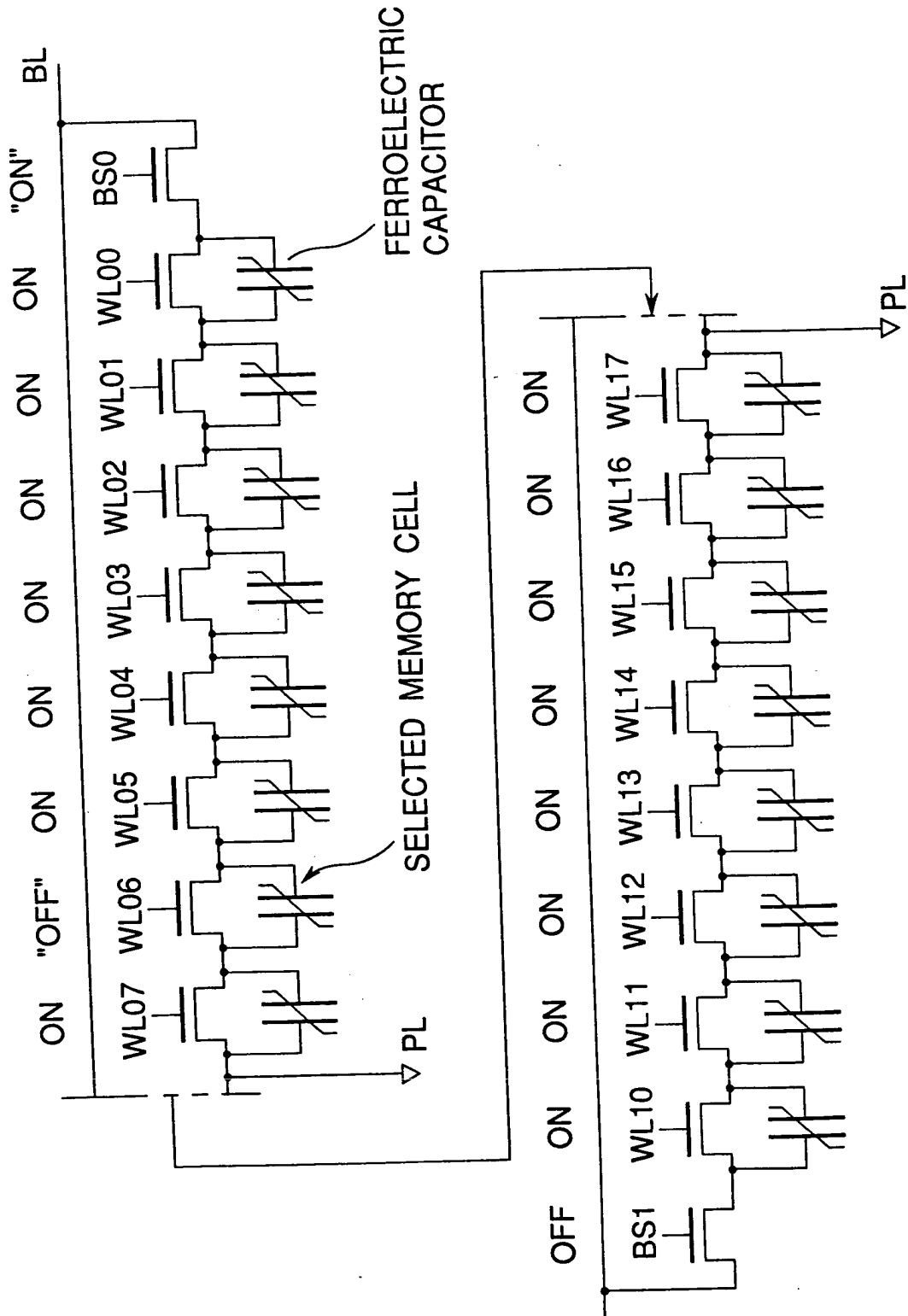


FIG. 25



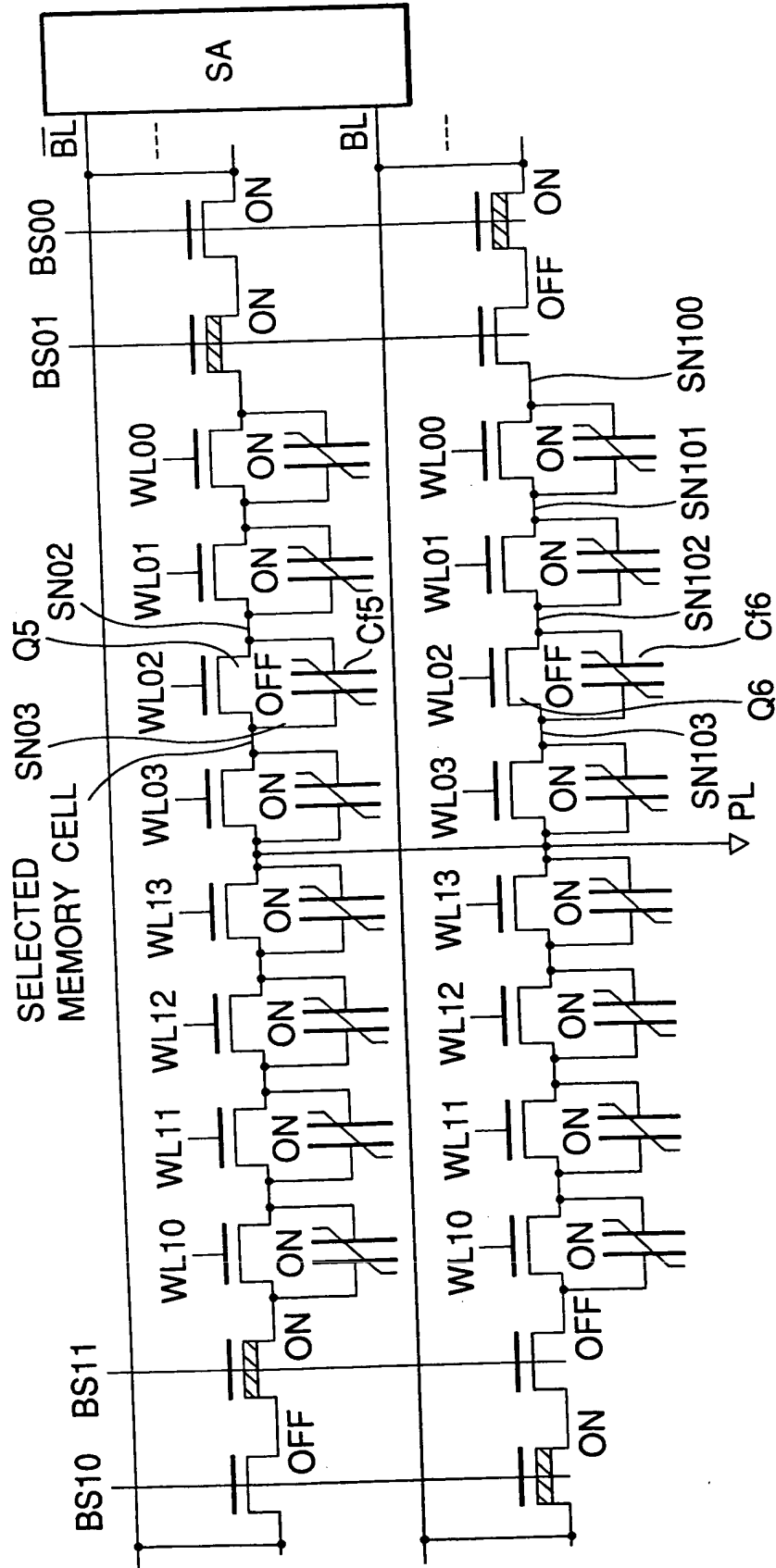


FIG.27

FIG. 28A

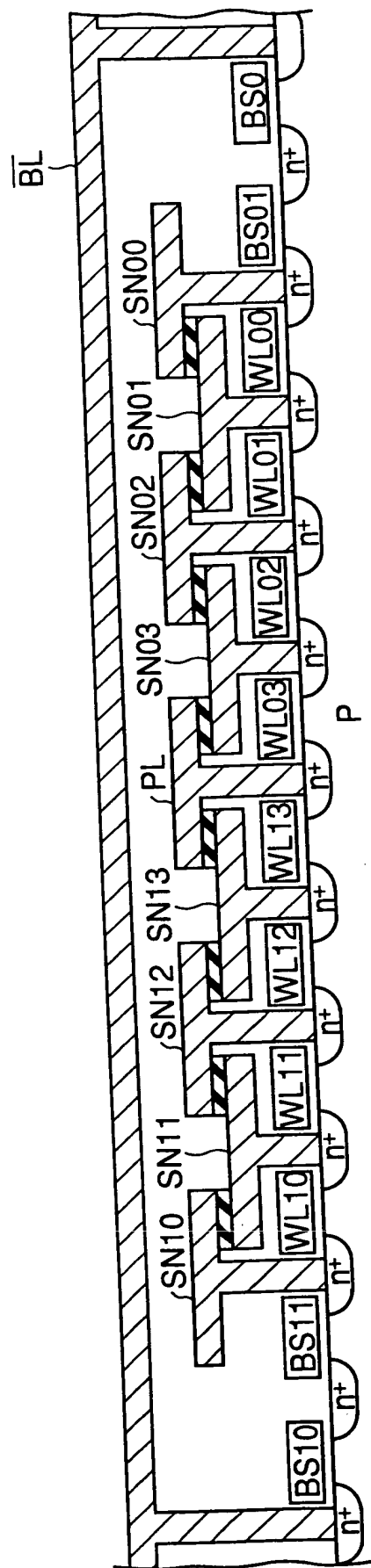


FIG. 28B

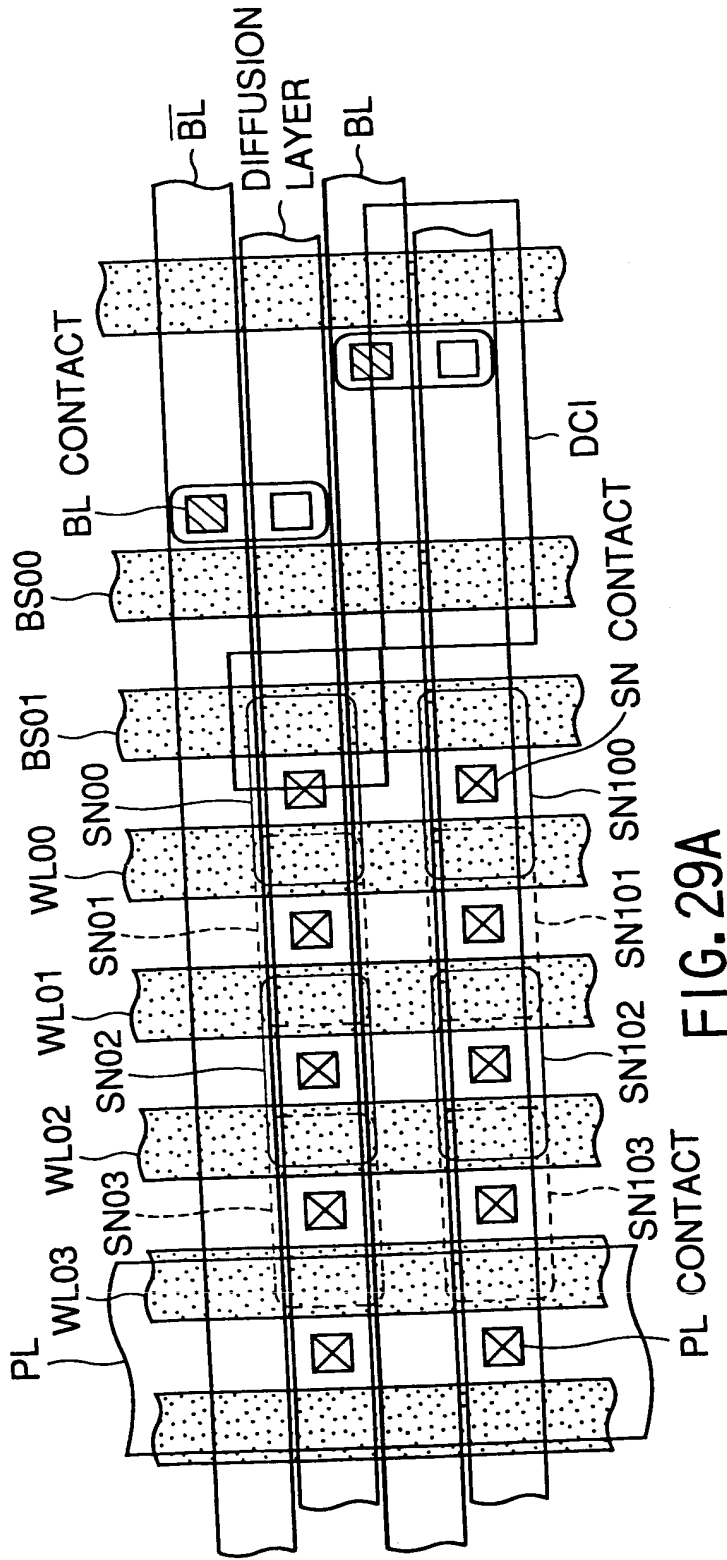


FIG. 29A

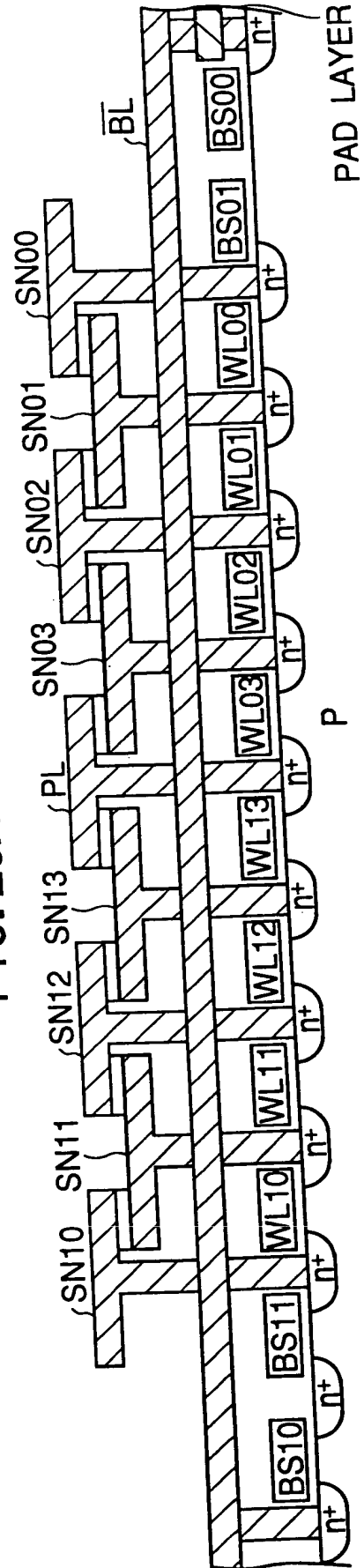


FIG. 29B

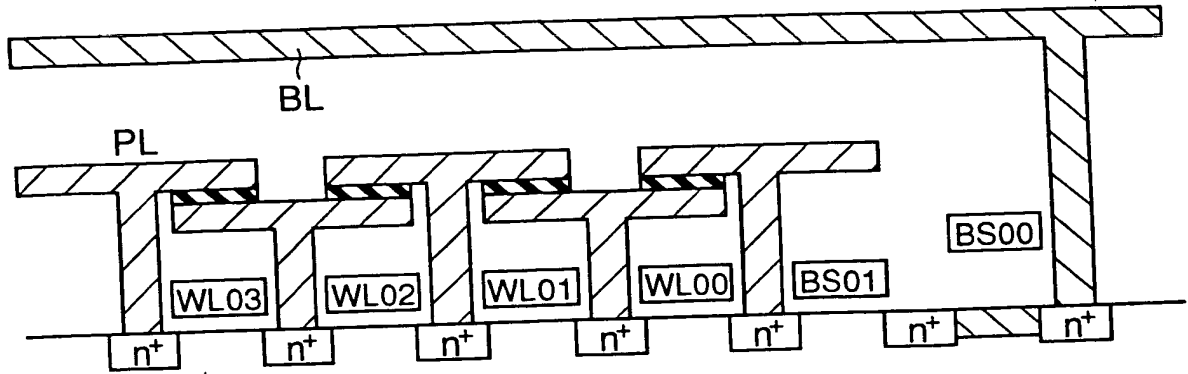


FIG. 30A

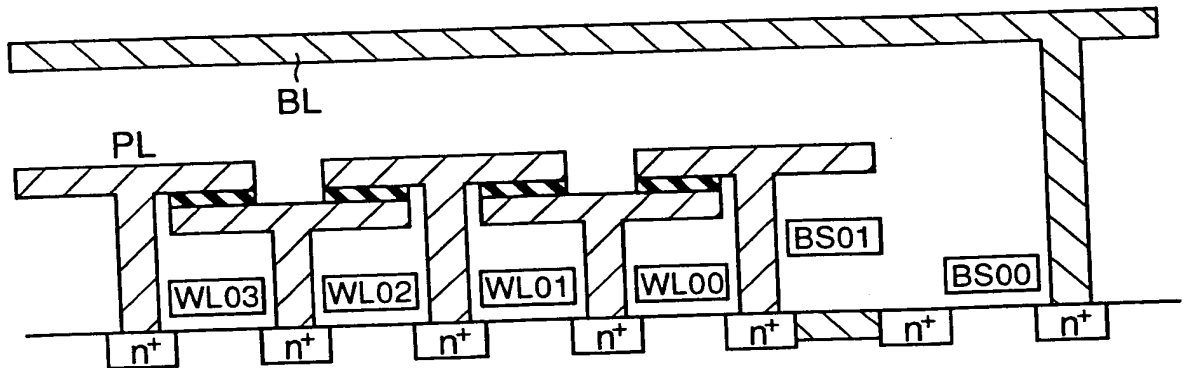


FIG. 30B

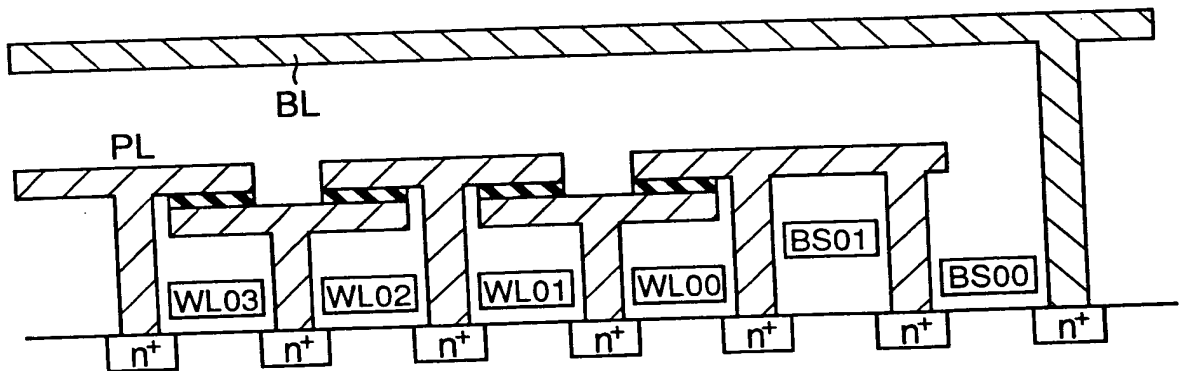


FIG. 30C

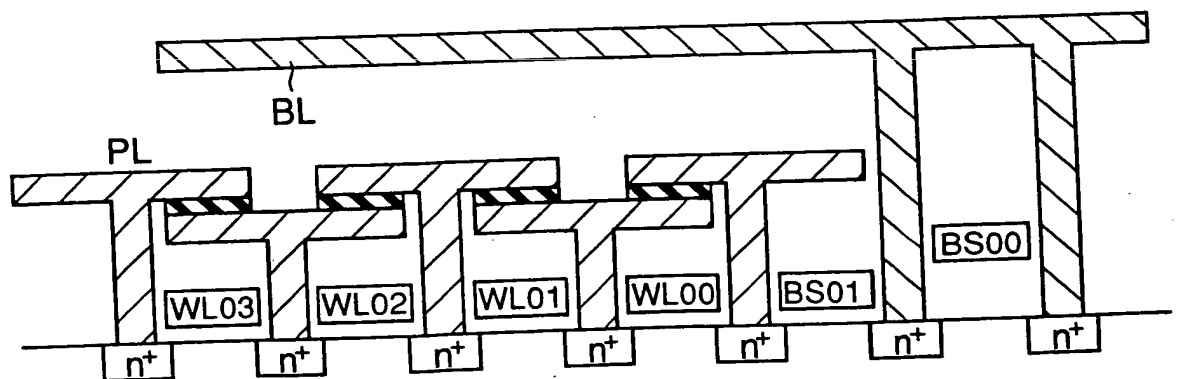


FIG. 30D

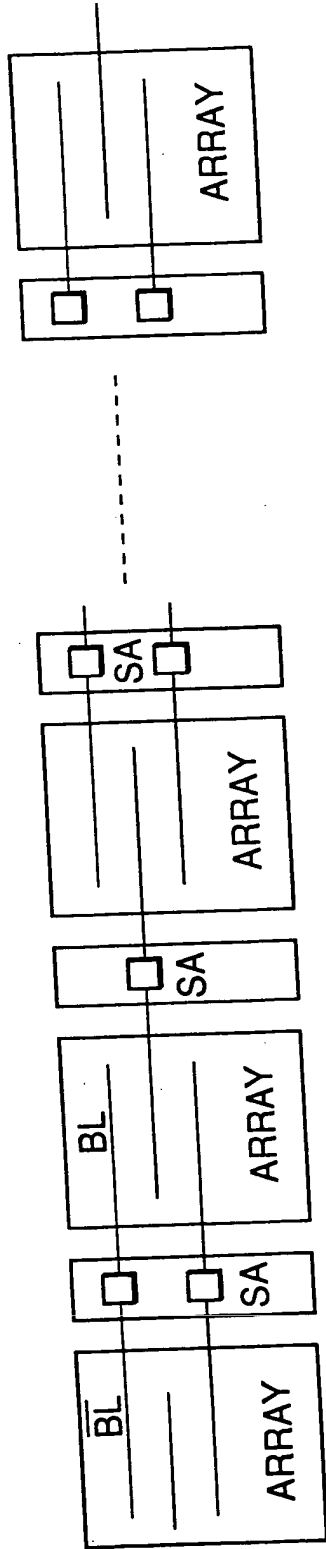


FIG. 31A

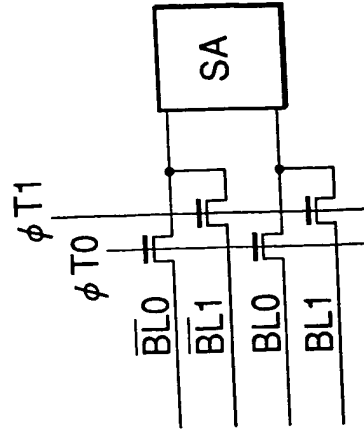


FIG. 31C

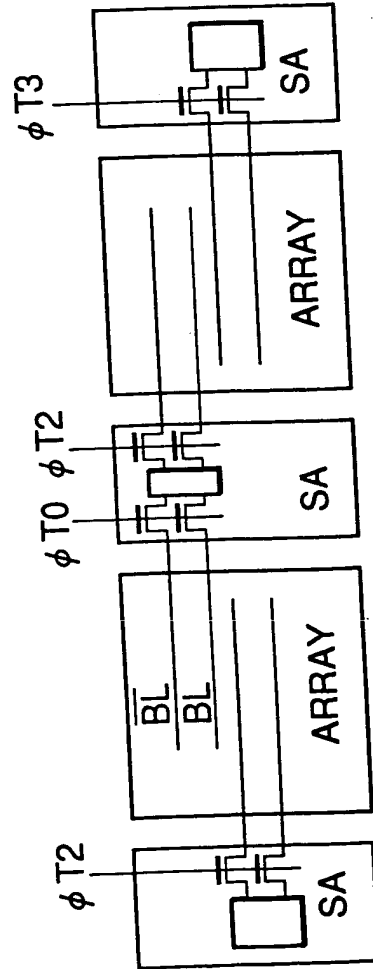


FIG. 31B

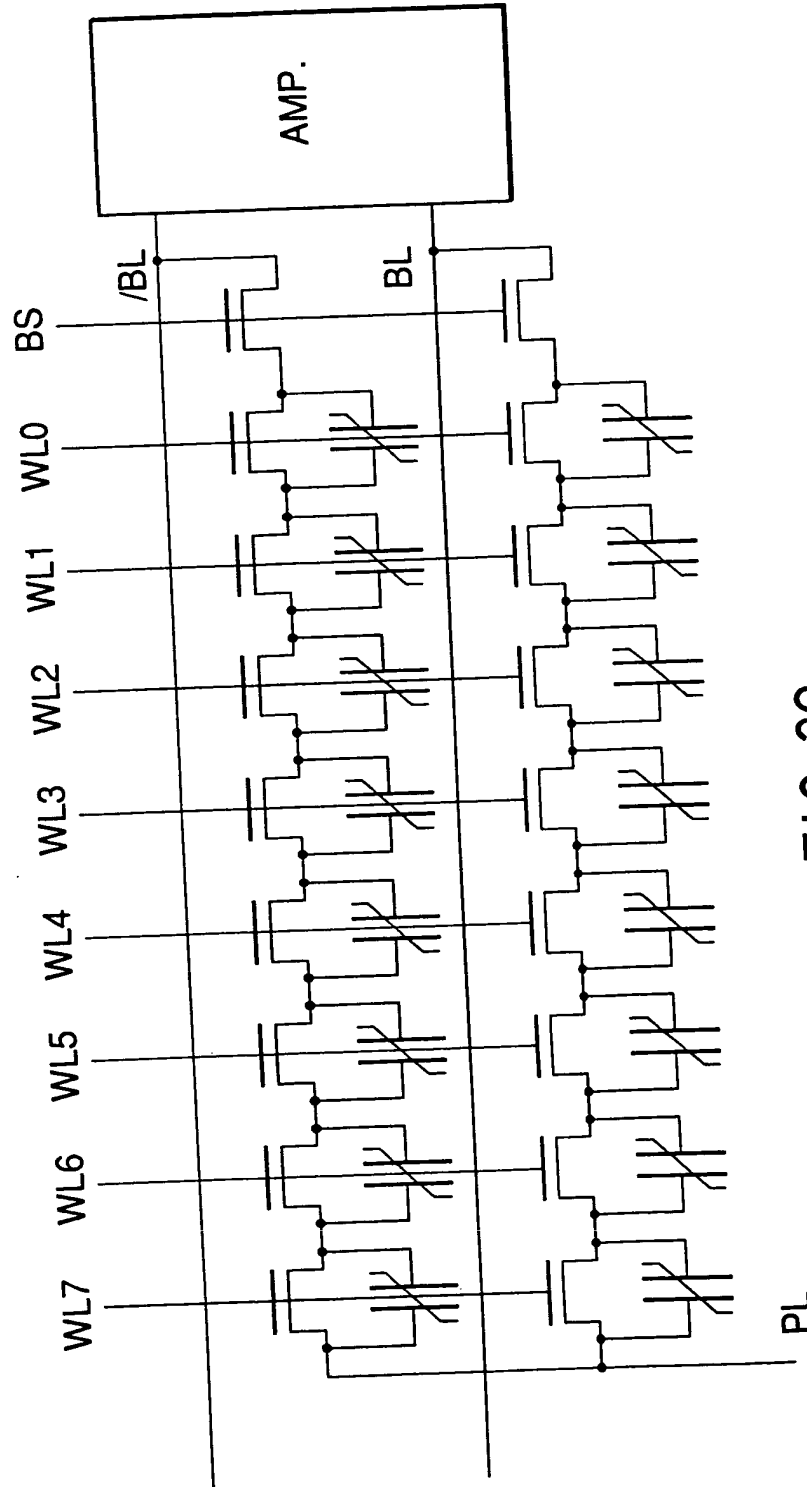


FIG. 32

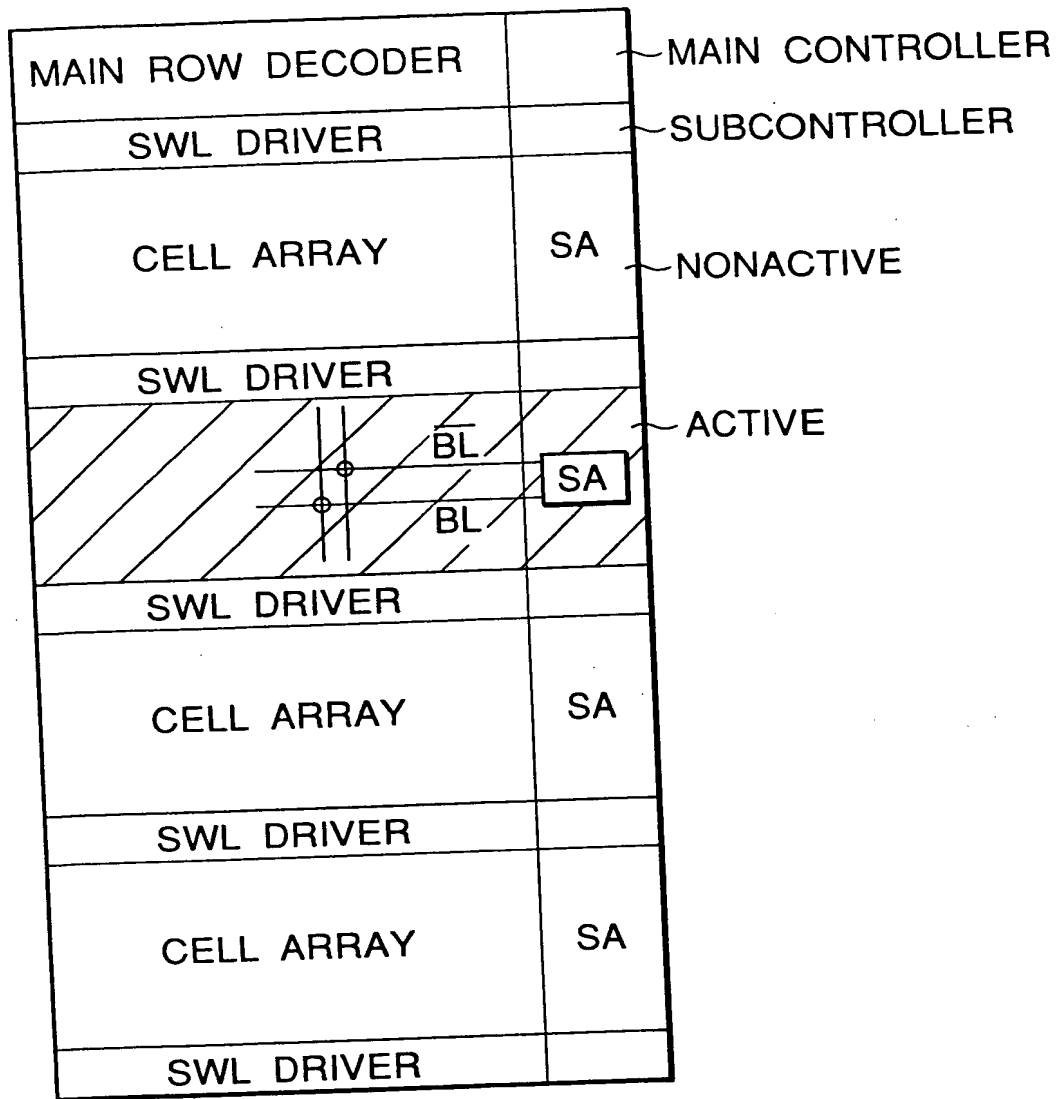


FIG. 33A

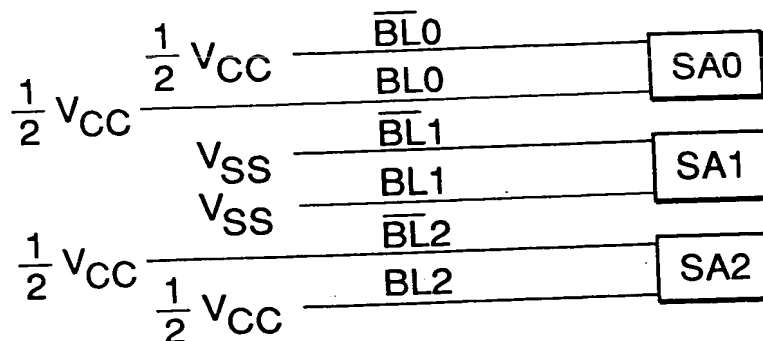
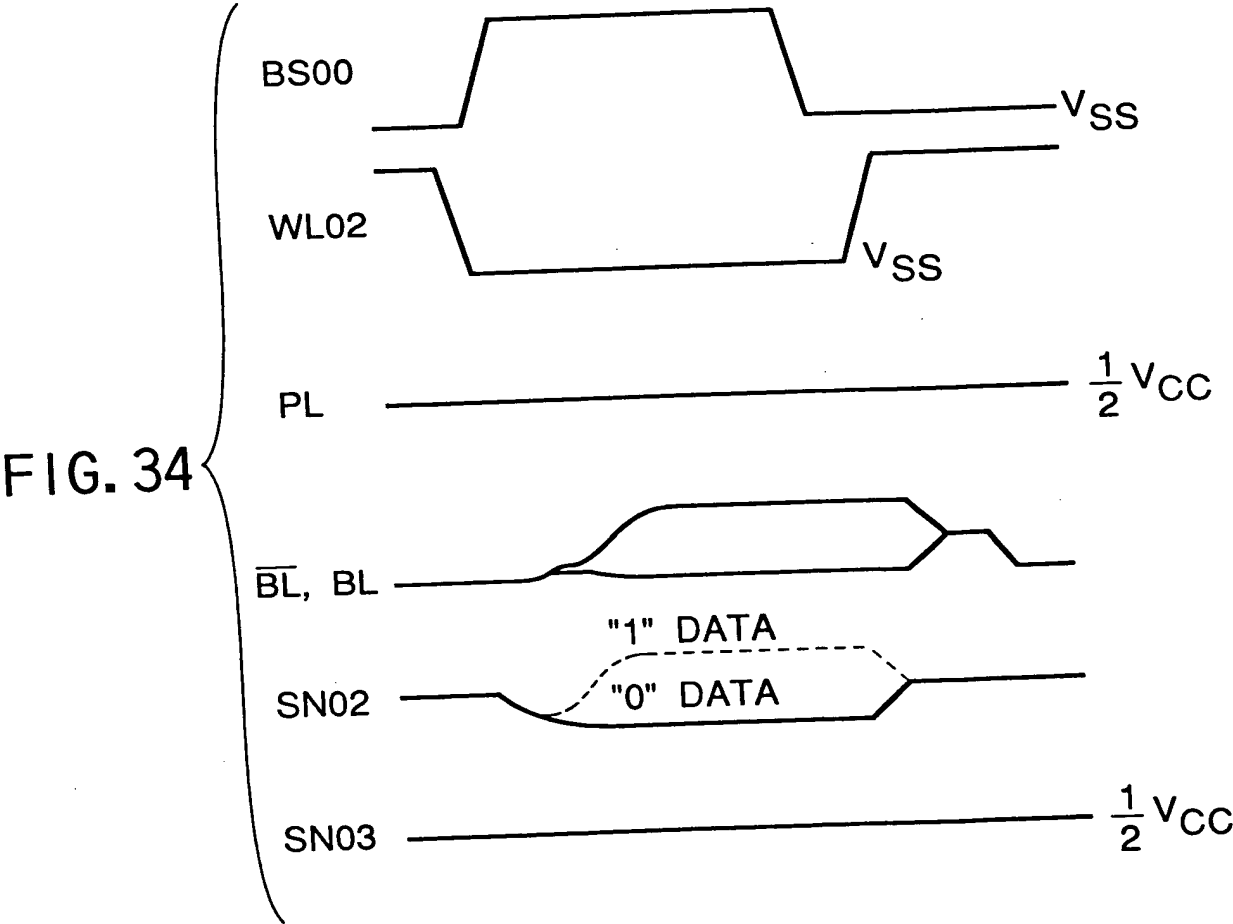
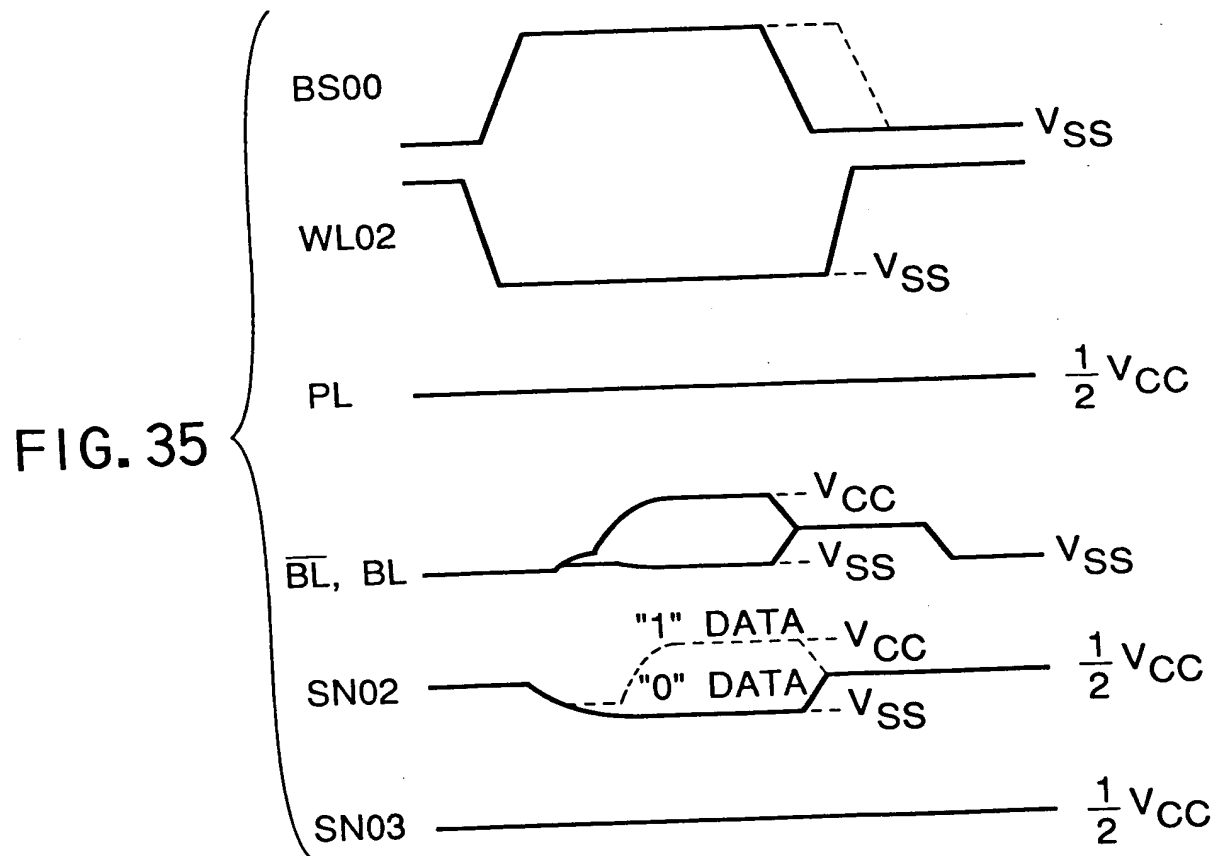


FIG. 33B





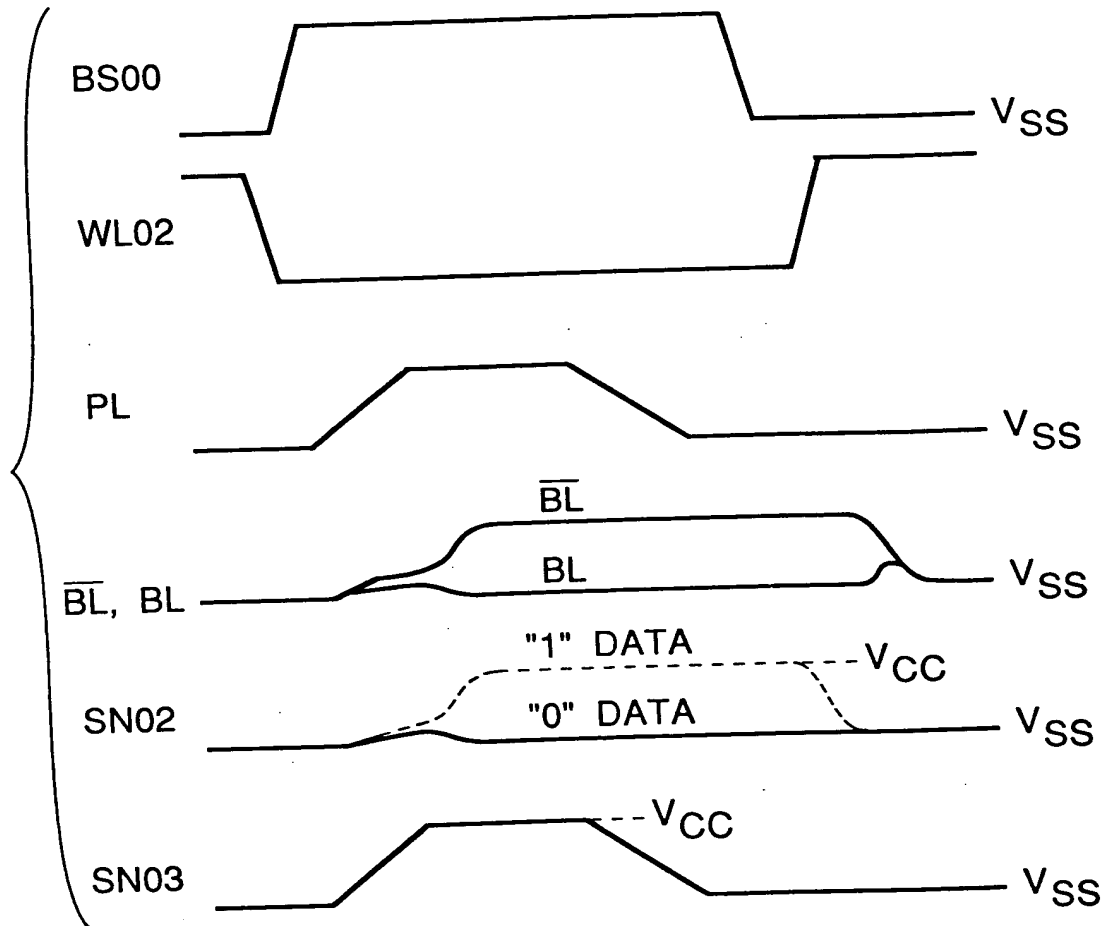


FIG. 36

	CHIP SIZE (COST)		TRANSISTOR STRUCTURE (EASE FOR) PROCESS	READ/WRITE METHOD (FLEXIBILITY)	NOISE (RELIABILITY)	(NO-) NONVOLATILE (PORTABILITY)
	CELL SIZE	BL CAPACITY (= CONSTANT)				
CONVENTIONAL 4F ² CELL	◎ 4F ²	△ LARGE (256WL/BL)	△ 75~90%	◎ RANDOM ACCESS	◎ SMALL (2-LAYER (FOLDED BL)	USABLE NONVOLATILE CELL
CONVENTIONAL NAND CELL	◎ 4.5~5F ² (4~2NAND)	○ MIDDLE (512WL/BL)	○ 71~74%	× BLOCK ACCESS	◎ SMALL (FOLDED BL (BY ADDING BS)	USABLE NONVOLATILE CELL
PRESENT INVENTION	◎ 4.5~5F ²	◎ SMALL (1024WL/BL)	◎ 62.5~64%	◎ RANDOM ACCESS	◎ SMALL	NONVOLATILE CELL
CONVENTIONAL 8F ² CELL	× 8F ²	○ MIDDLE (512WL/BL)	× 100%	◎ RANDOM ACCESS	◎ SMALL (FOLDED BL)	USABLE NONVOLATILE CELL

NOTE)
NESTING ≤ 4

CONDITION IN 100% CHIP (MEMORY CELL 60%
SA 20%
PERIPHERAL CIRCUIT 20%)) NOTE)
BL IS MADE TO DOUBLE LAYERED
COST INCREASES 7%

FIG. 37

	PLATE ELECTRODE DRIVING (SPEED, POWER)	REFRESH OPERATION (POWER, BUSY RATE)
CONVENTIONAL FRAM	CASE 1 EXIST x	UNNECESSARY ⊙
	CASE 2 $\frac{1}{2} V_{CC}$ FIXED ⊙	NECESSARY x
PRESENT INVENTION	$\frac{1}{2} V_{CC}$ FIXED ⊙	UNNECESSARY ⊙

FIG. 38

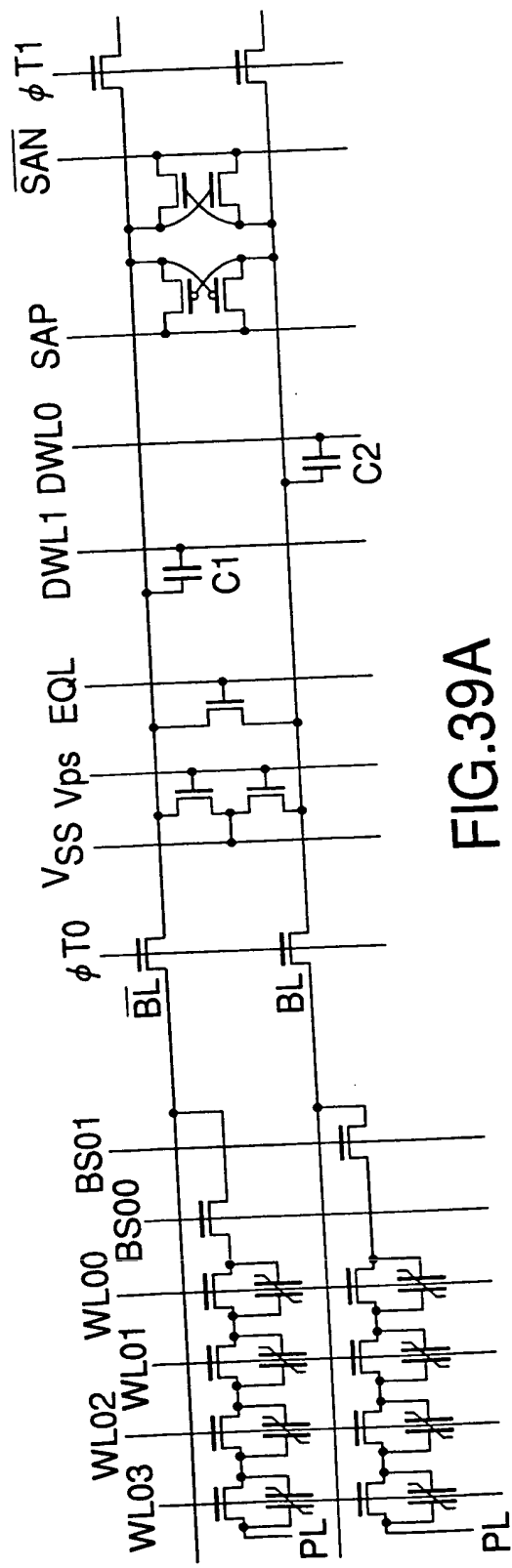


FIG. 39A

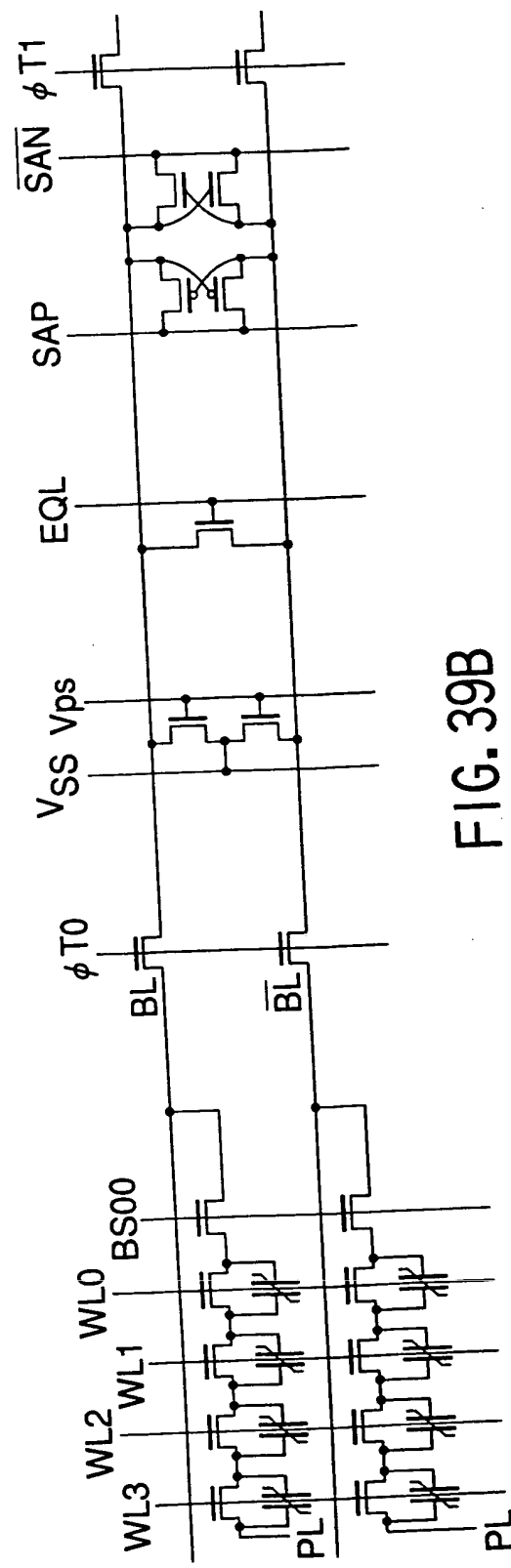


FIG. 39B

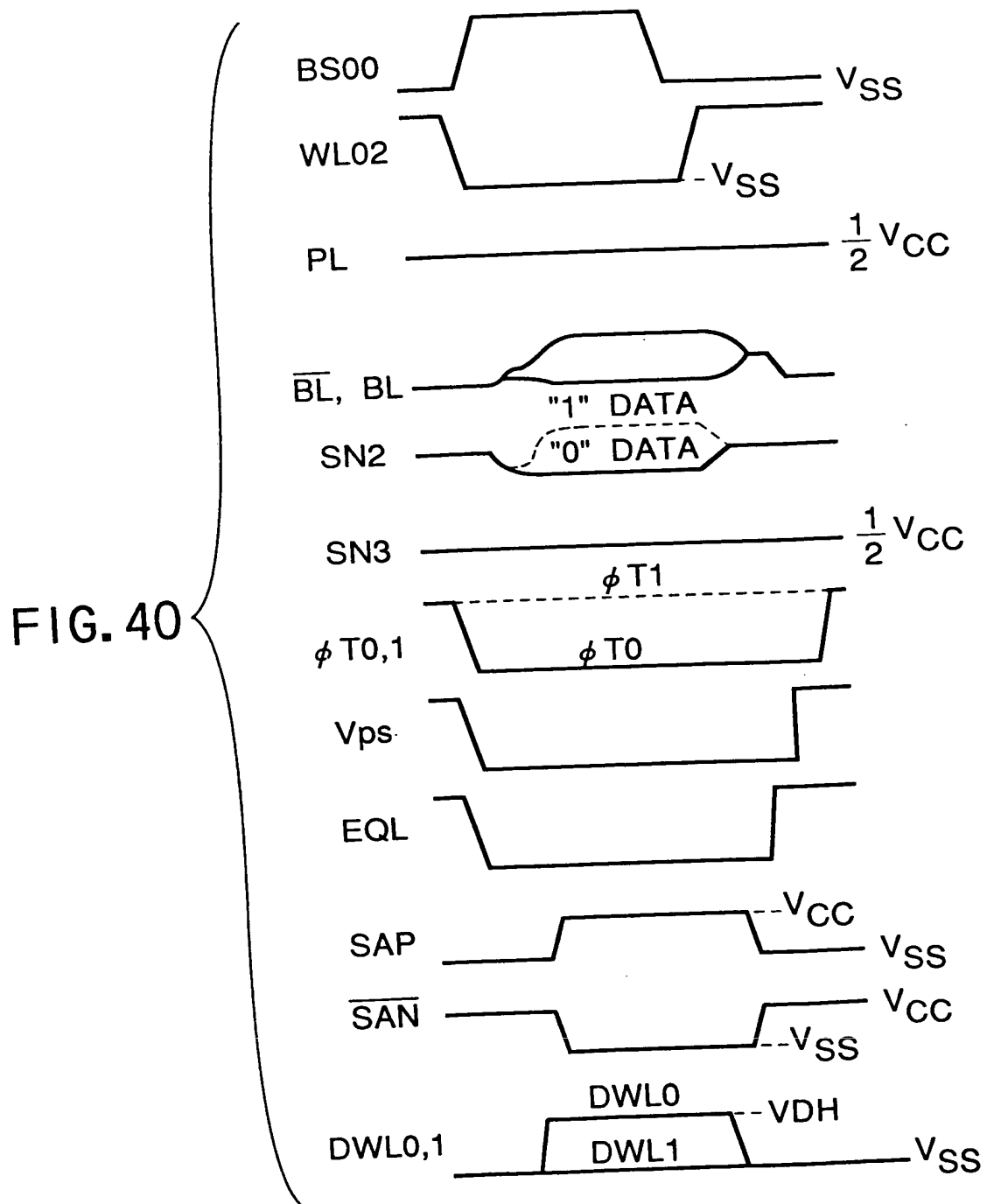


FIG. 41A

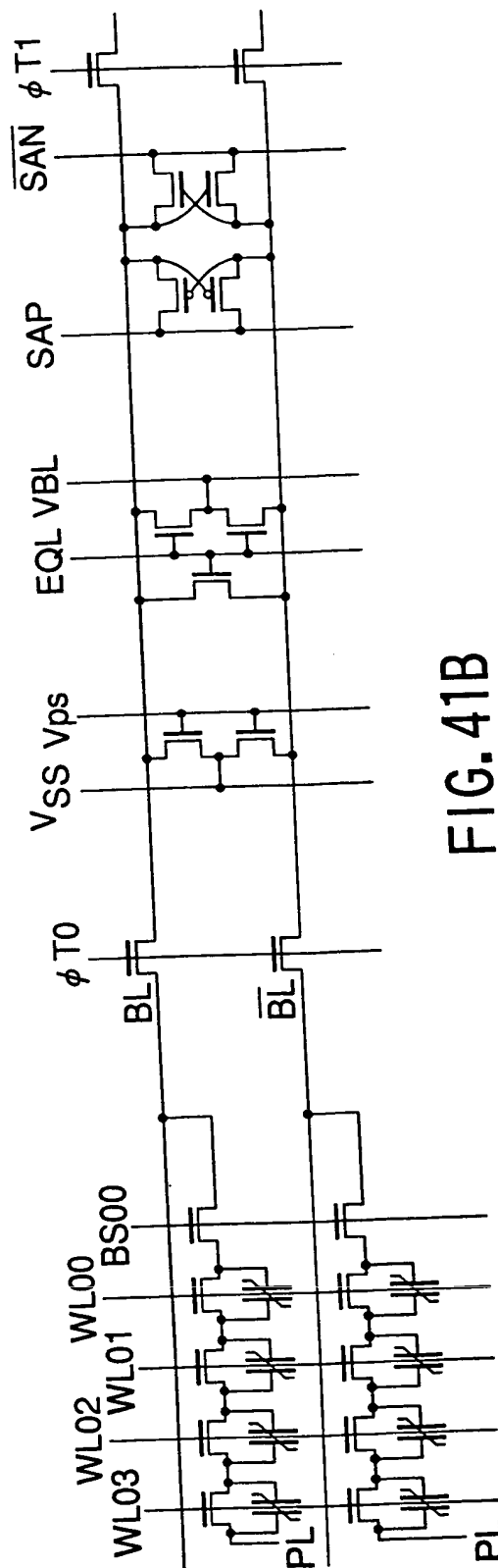
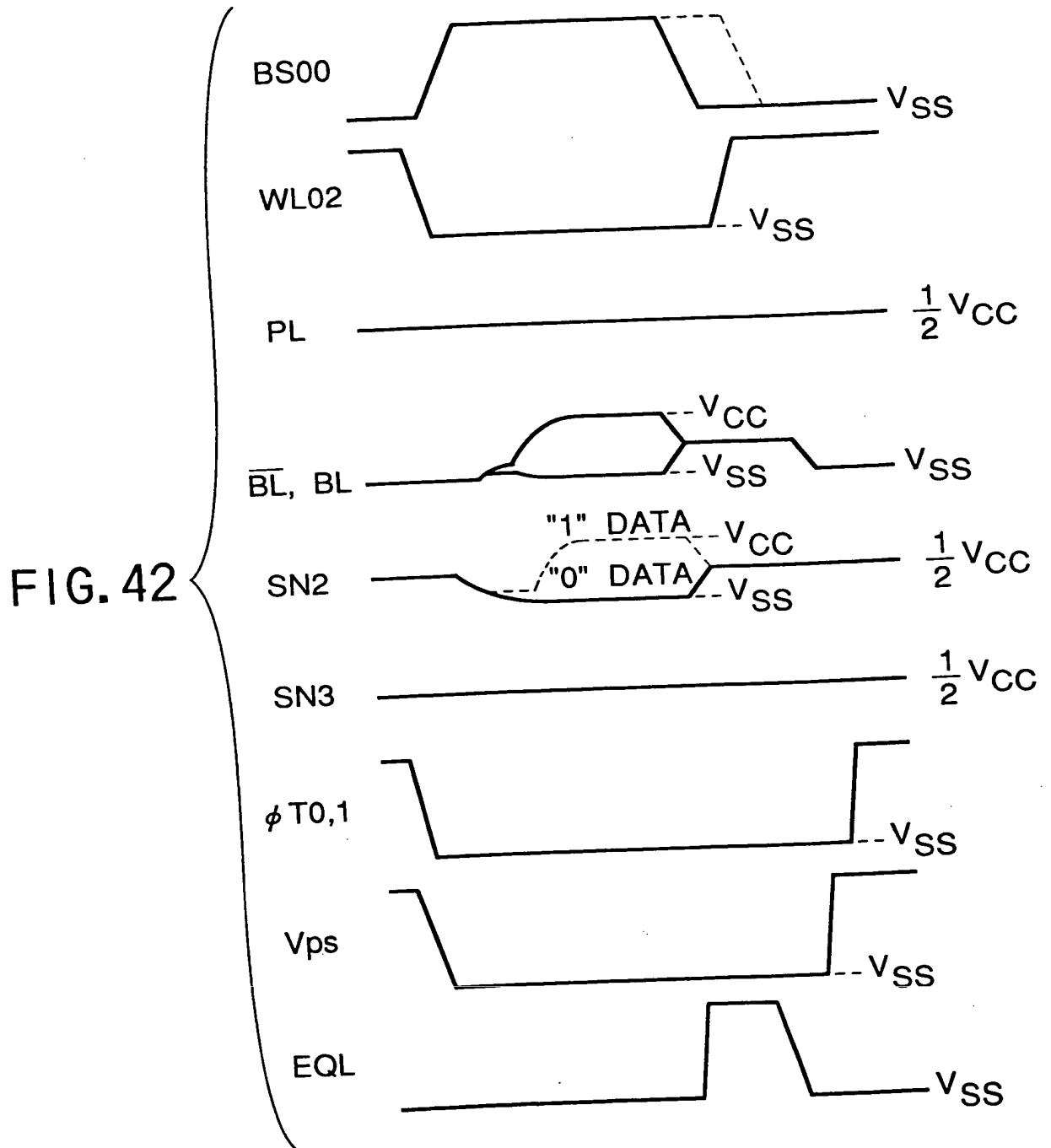


FIG. 41B



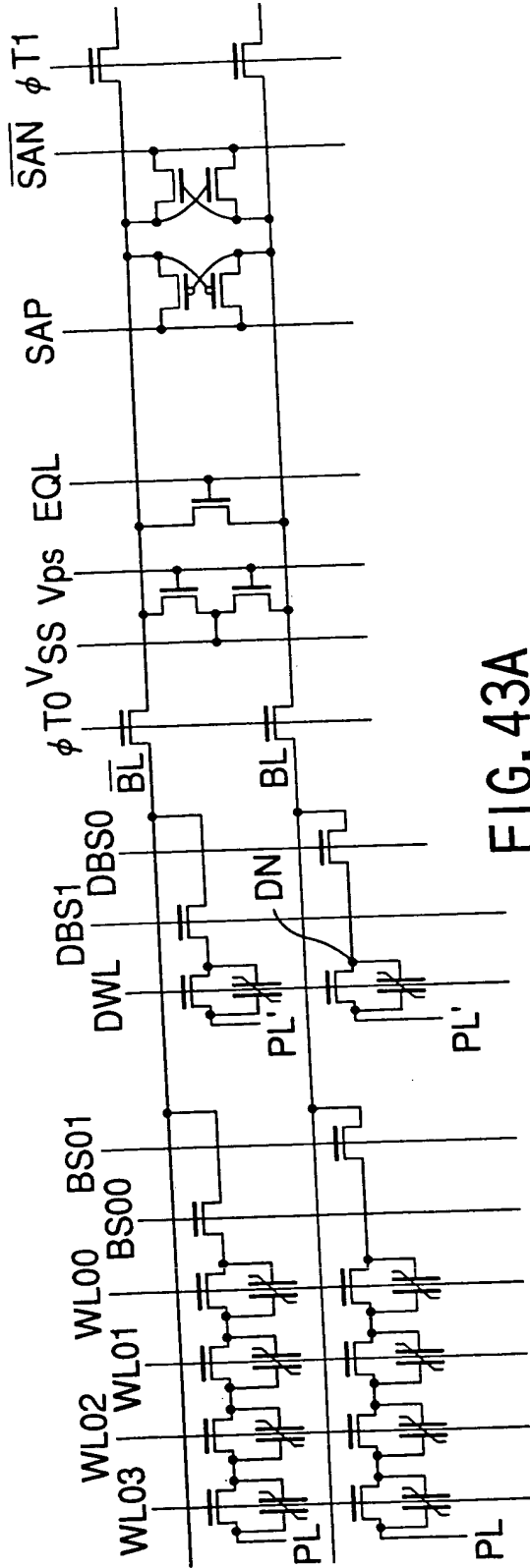


FIG. 43A

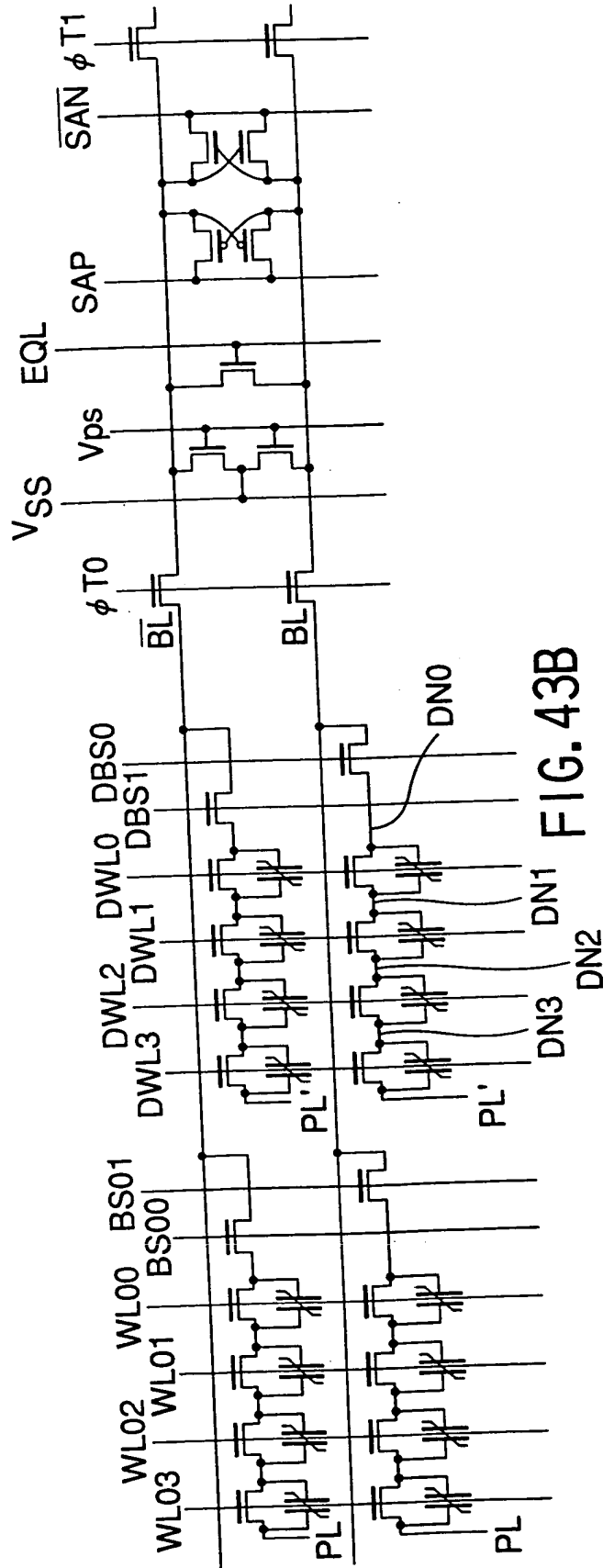
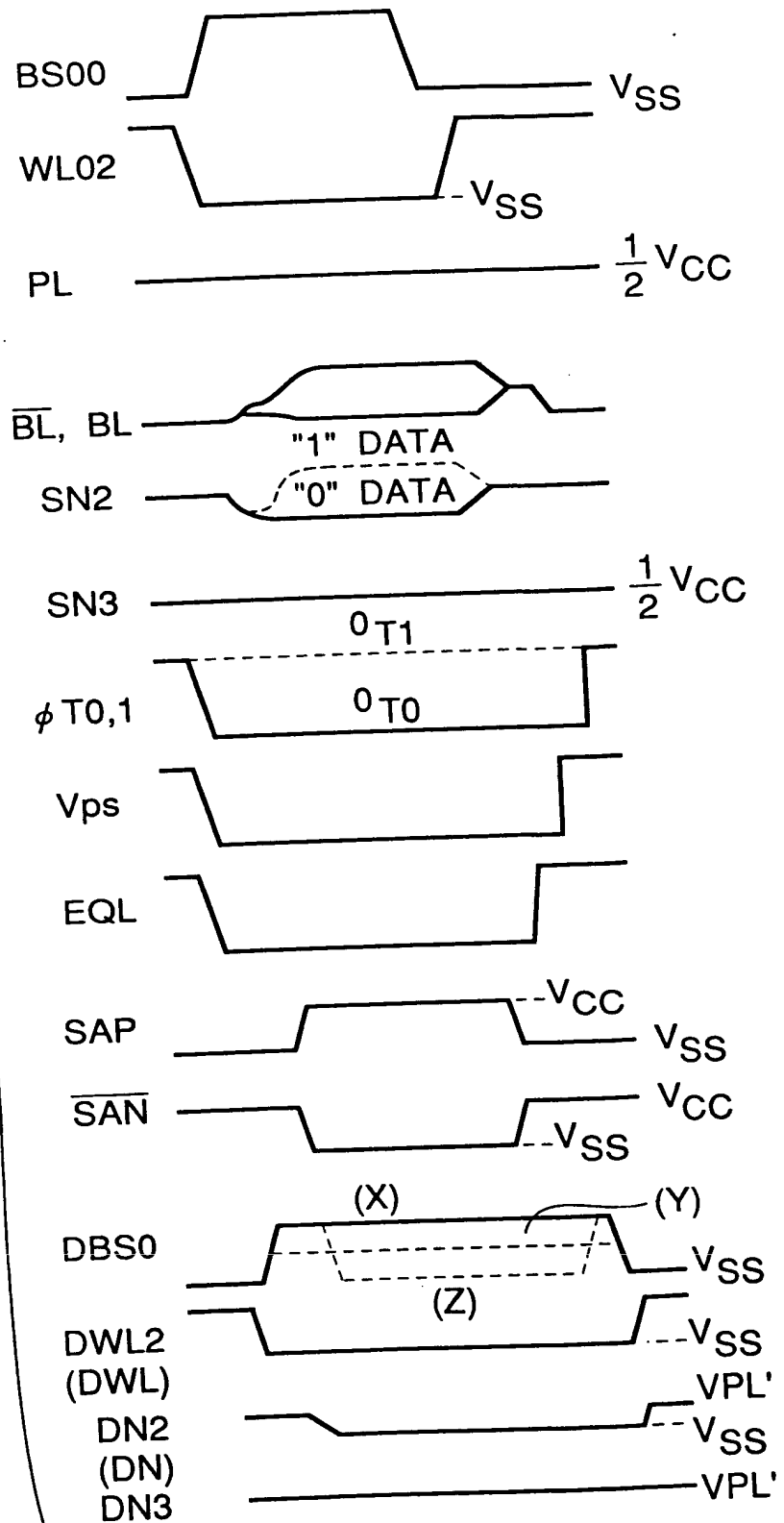


FIG. 43B

FIG. 44



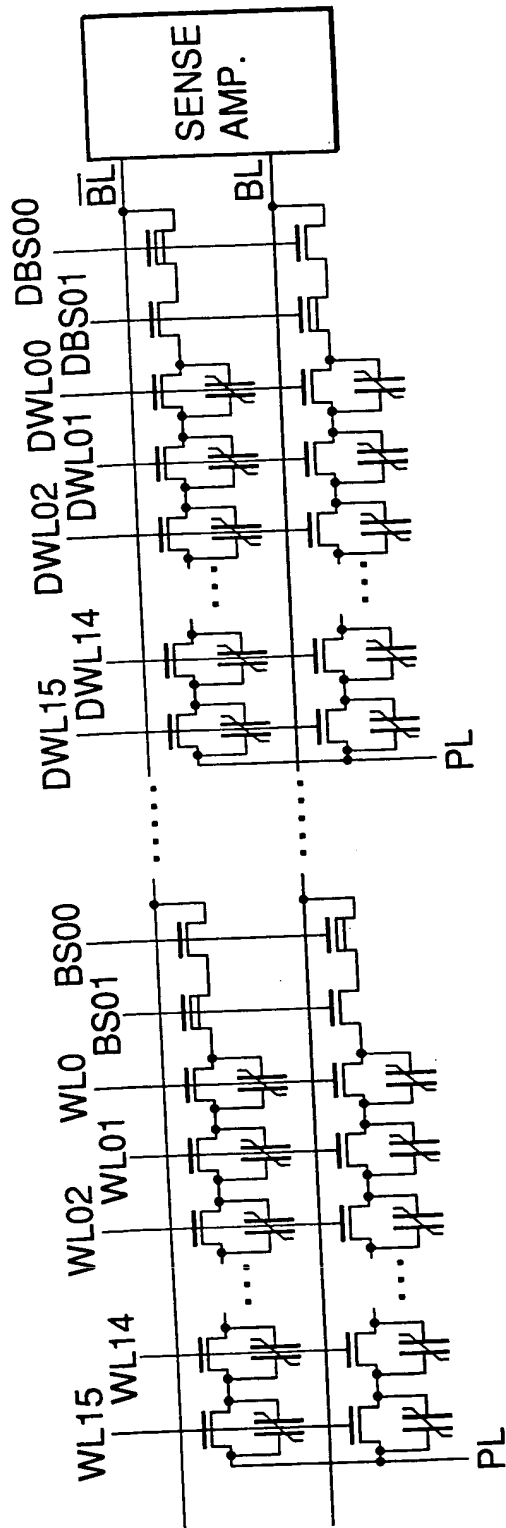


FIG. 45A

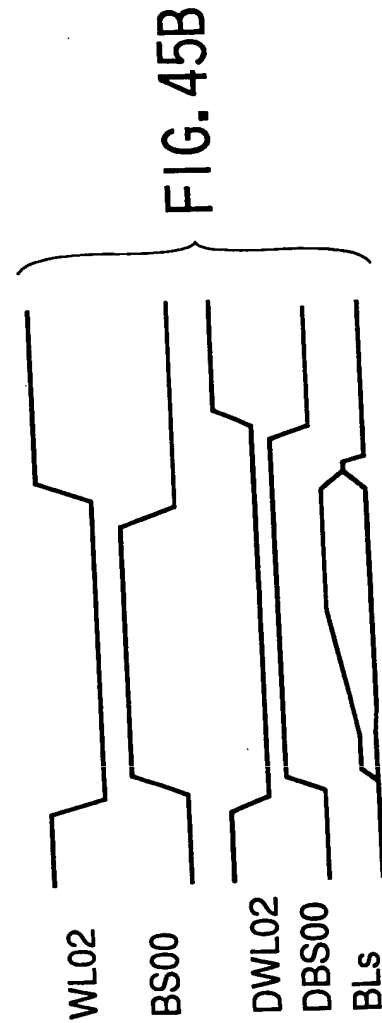


FIG. 45B

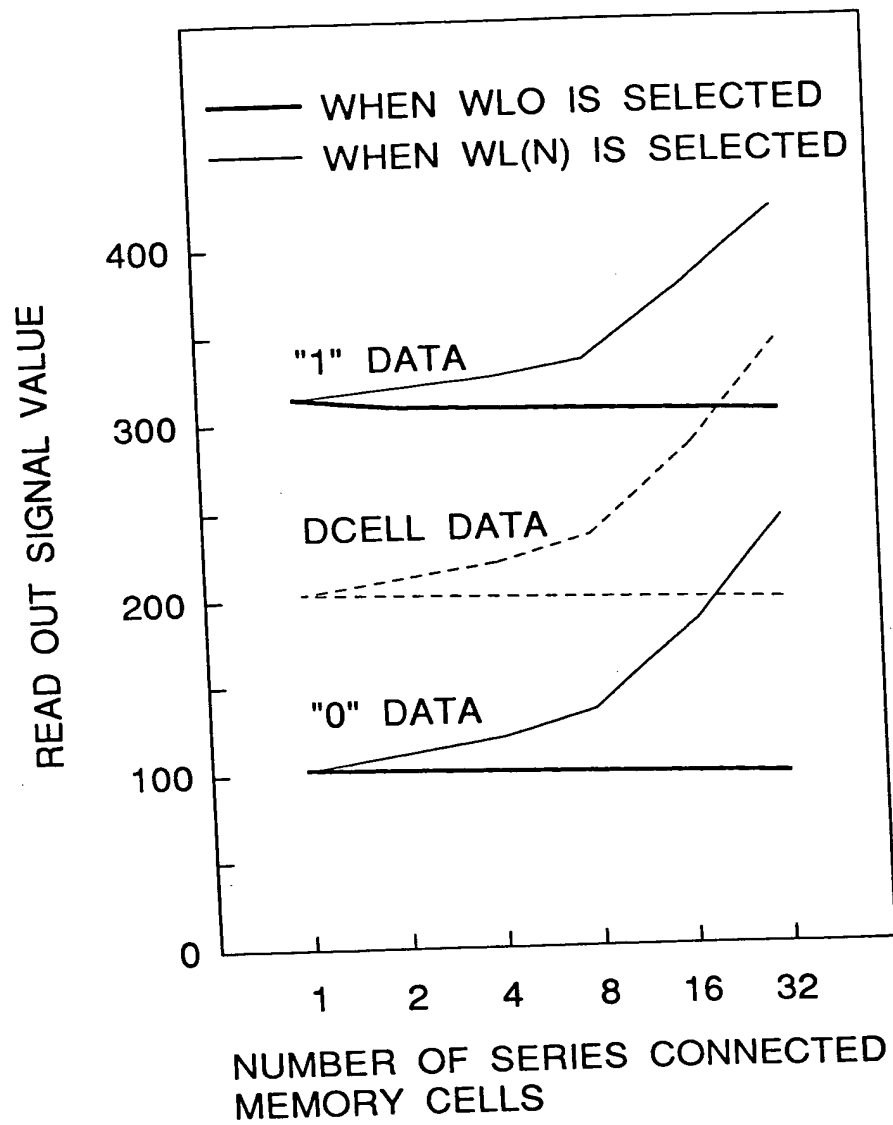


FIG. 46

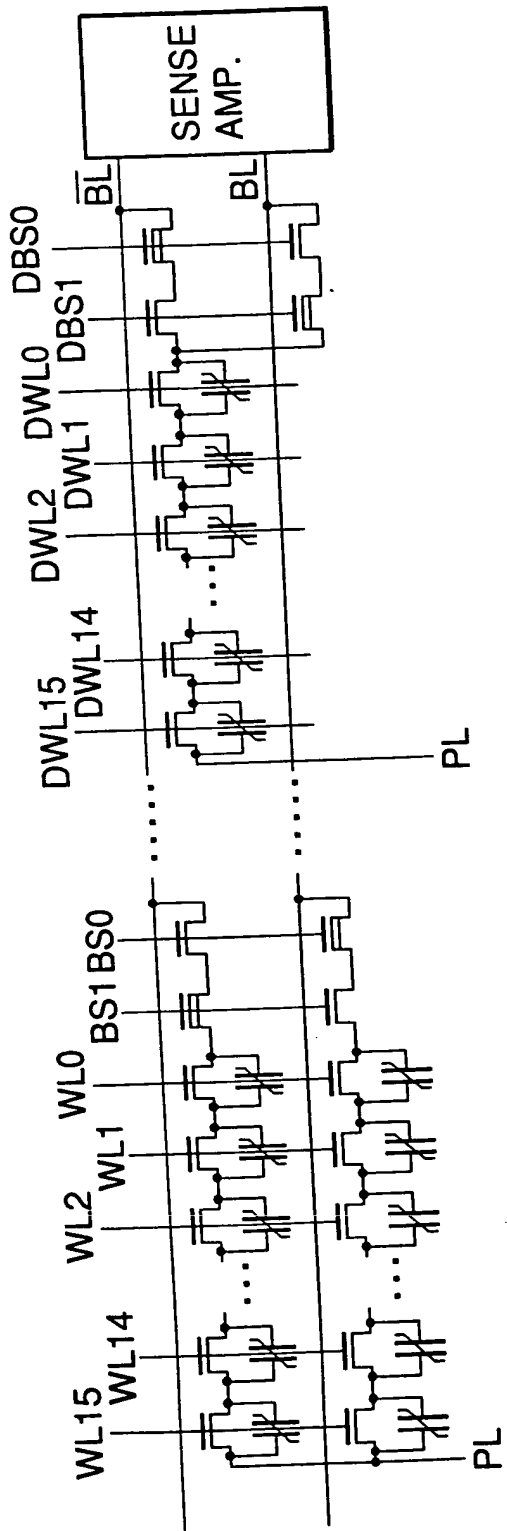


FIG. 47A

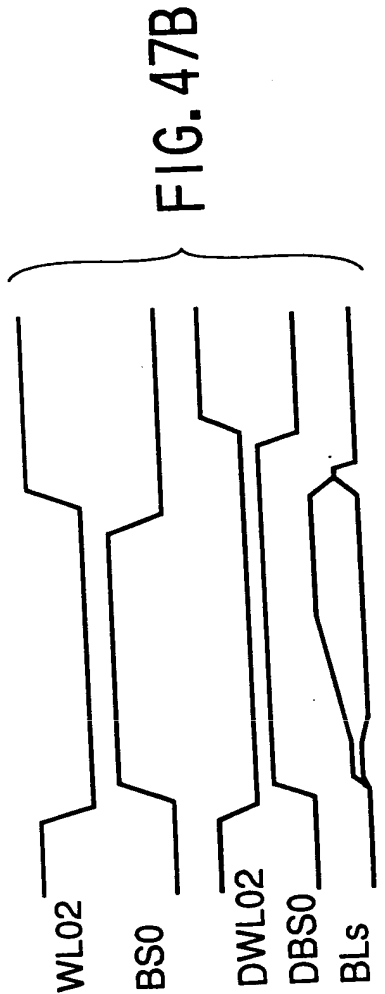


FIG. 47B

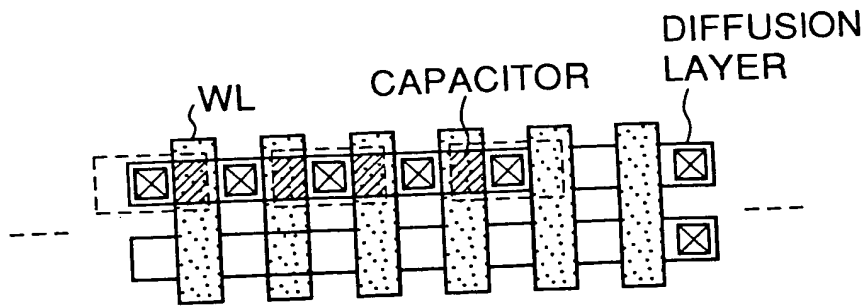


FIG. 48A

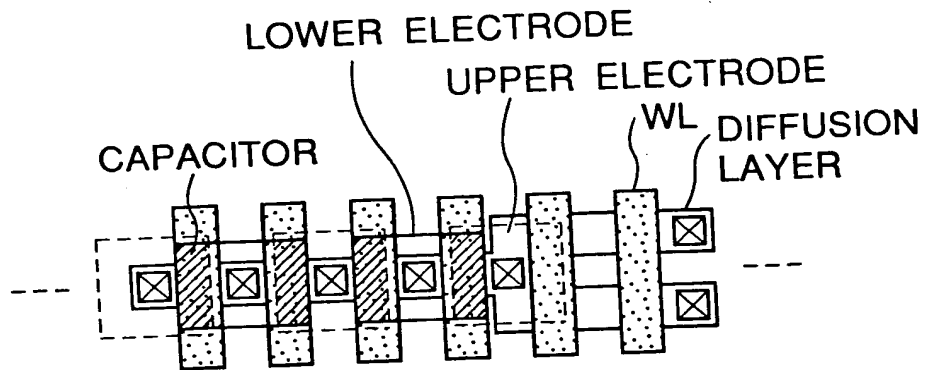


FIG. 48B

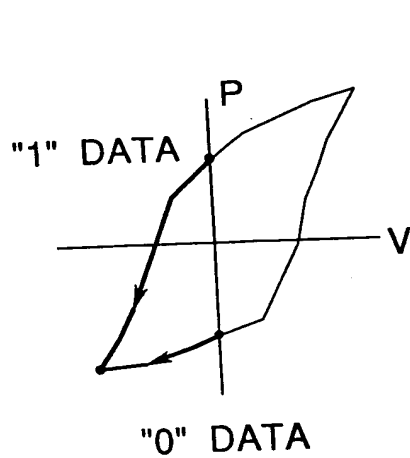


FIG. 48C

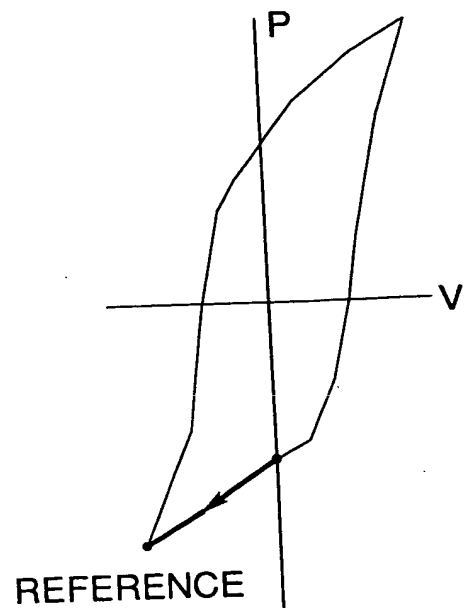


FIG. 48D

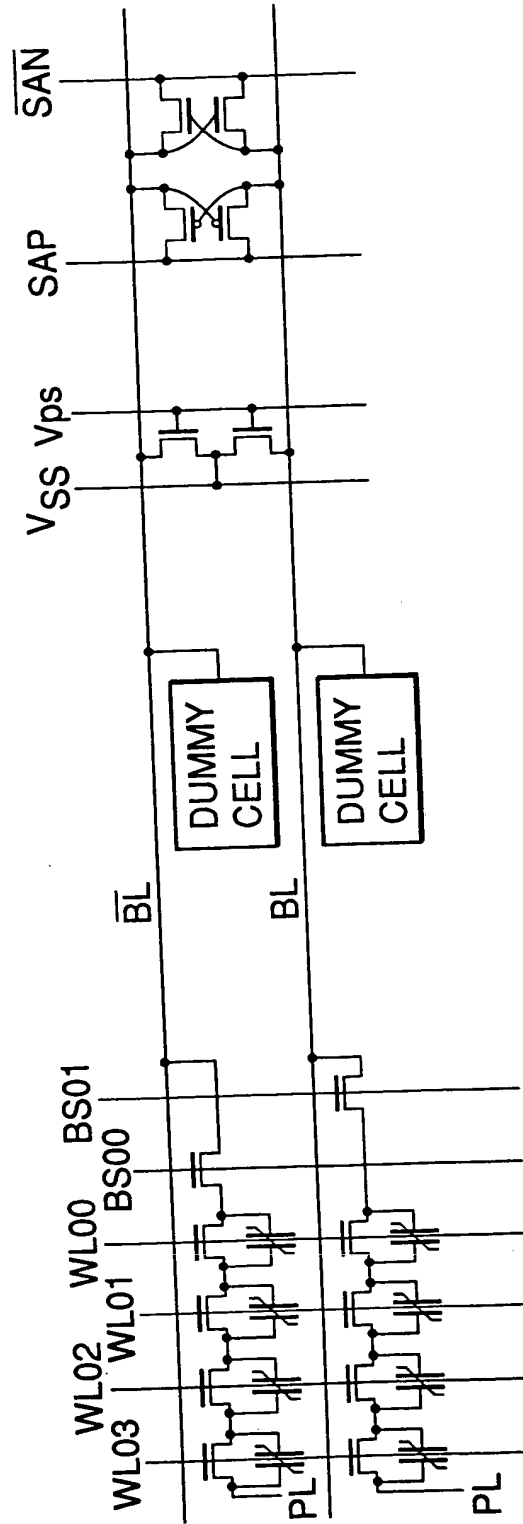


FIG. 49

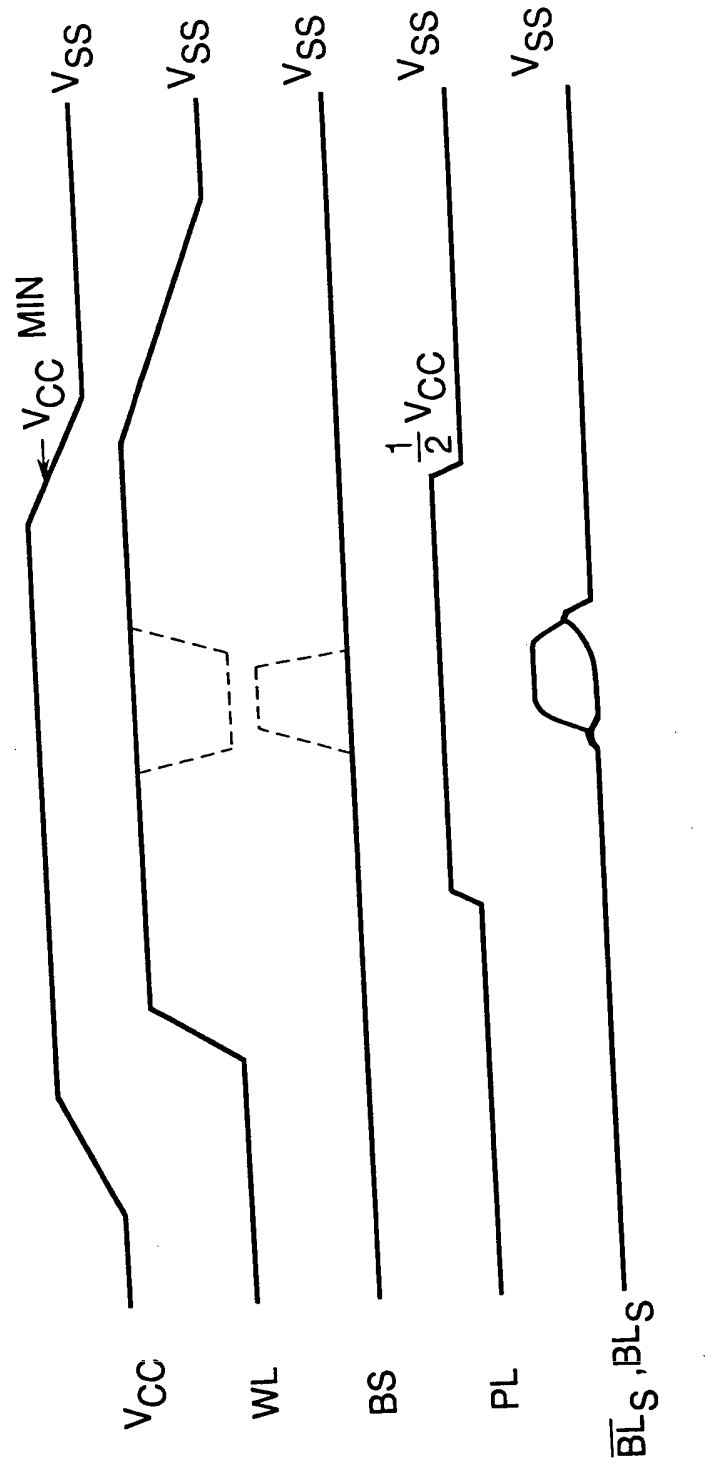
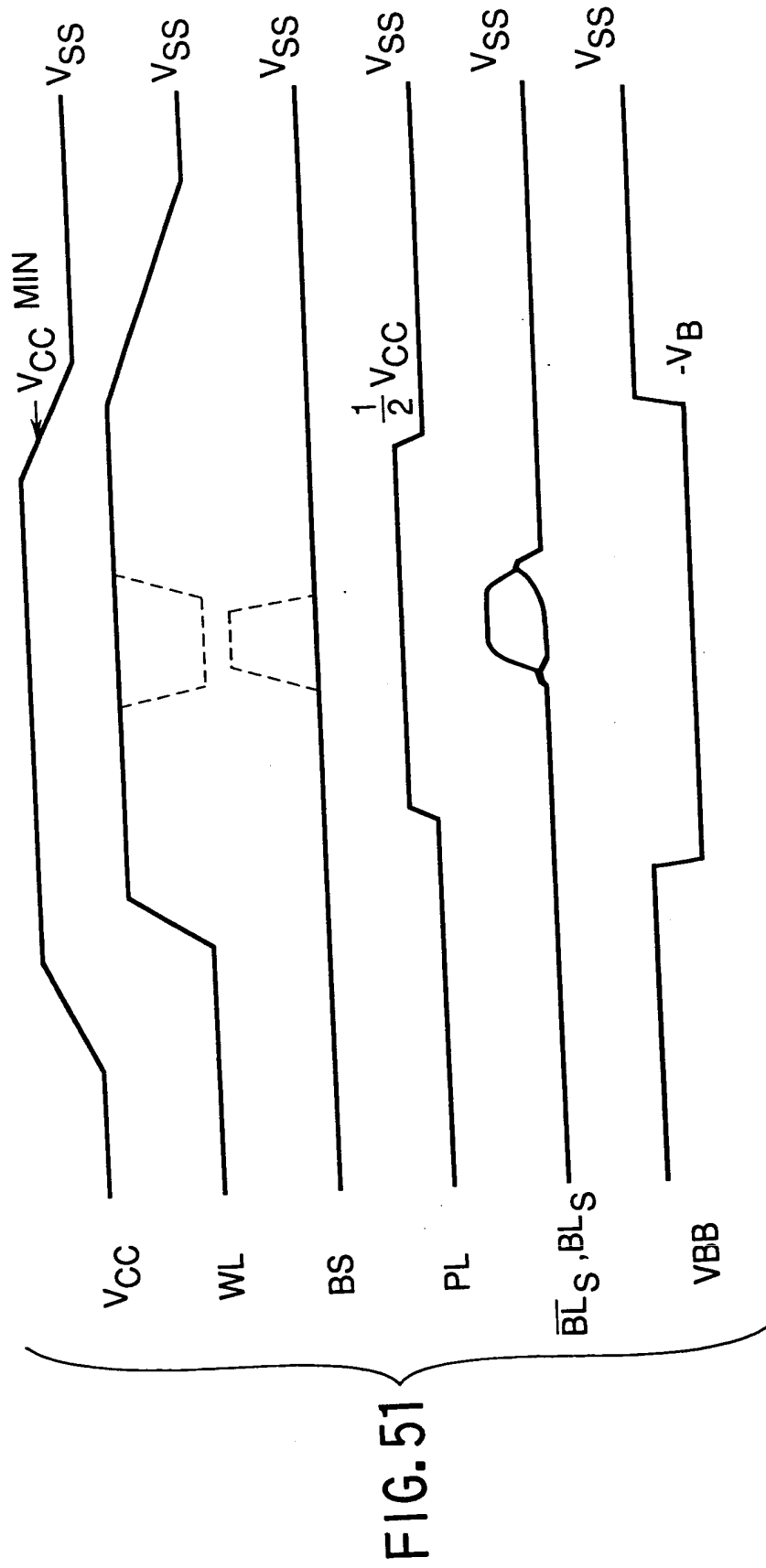


FIG. 50



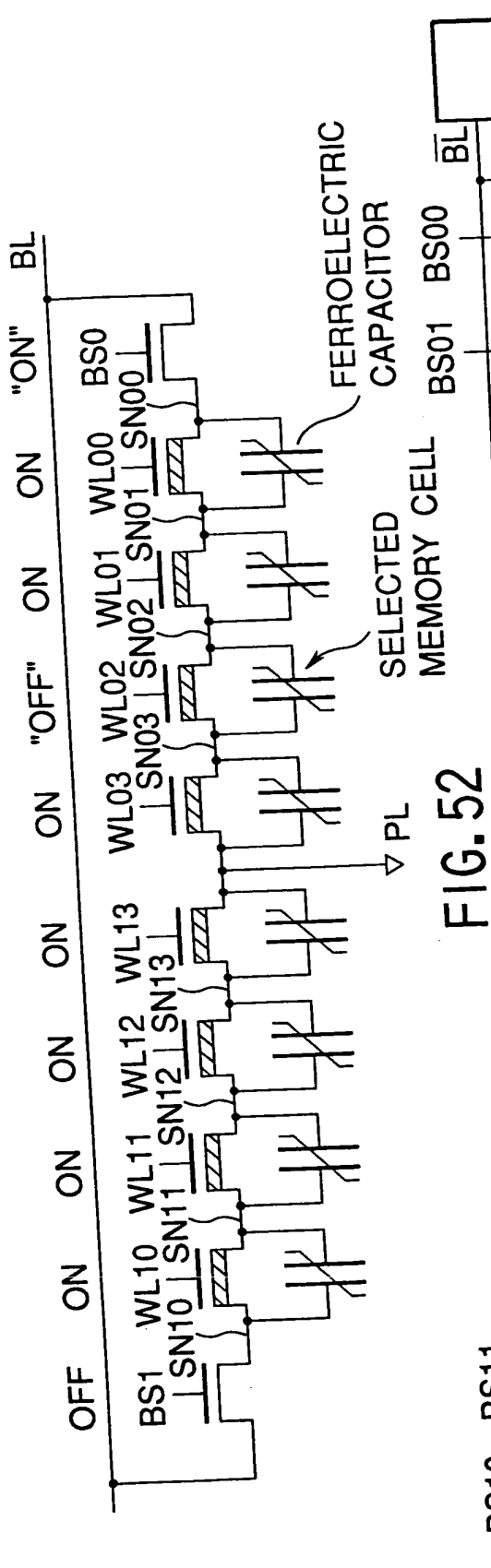


FIG. 52

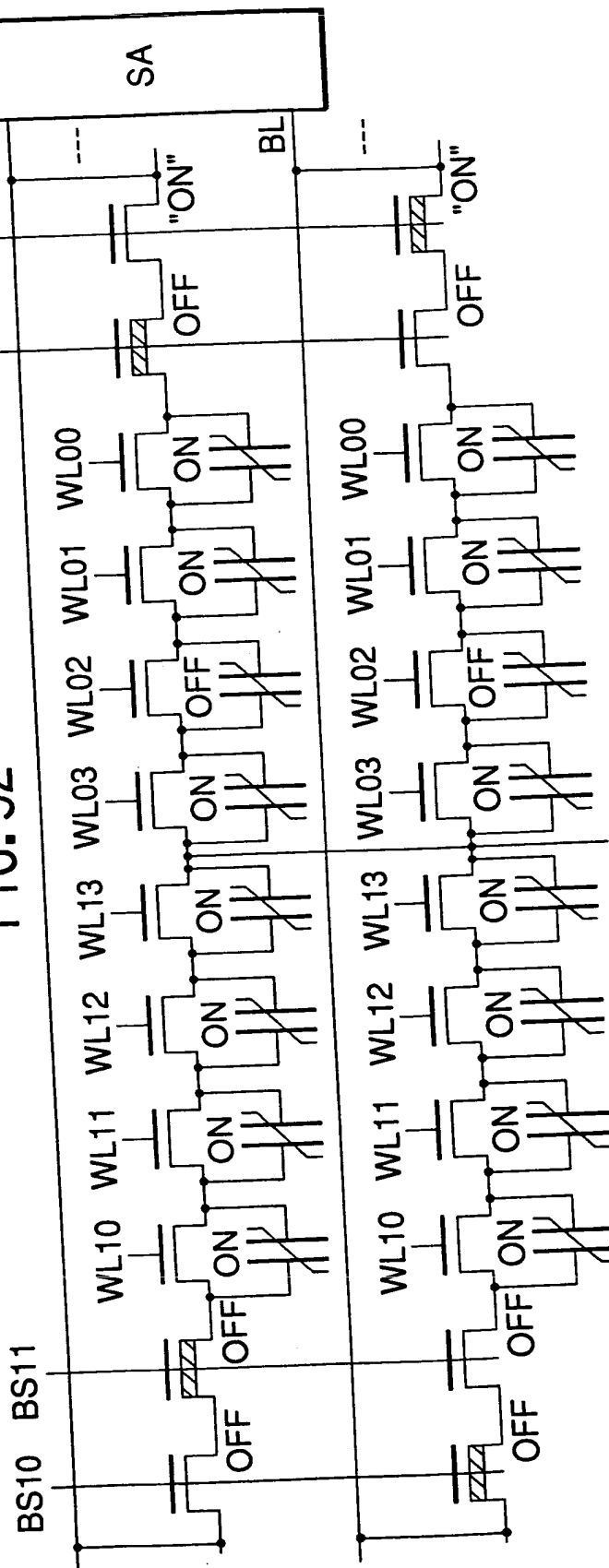
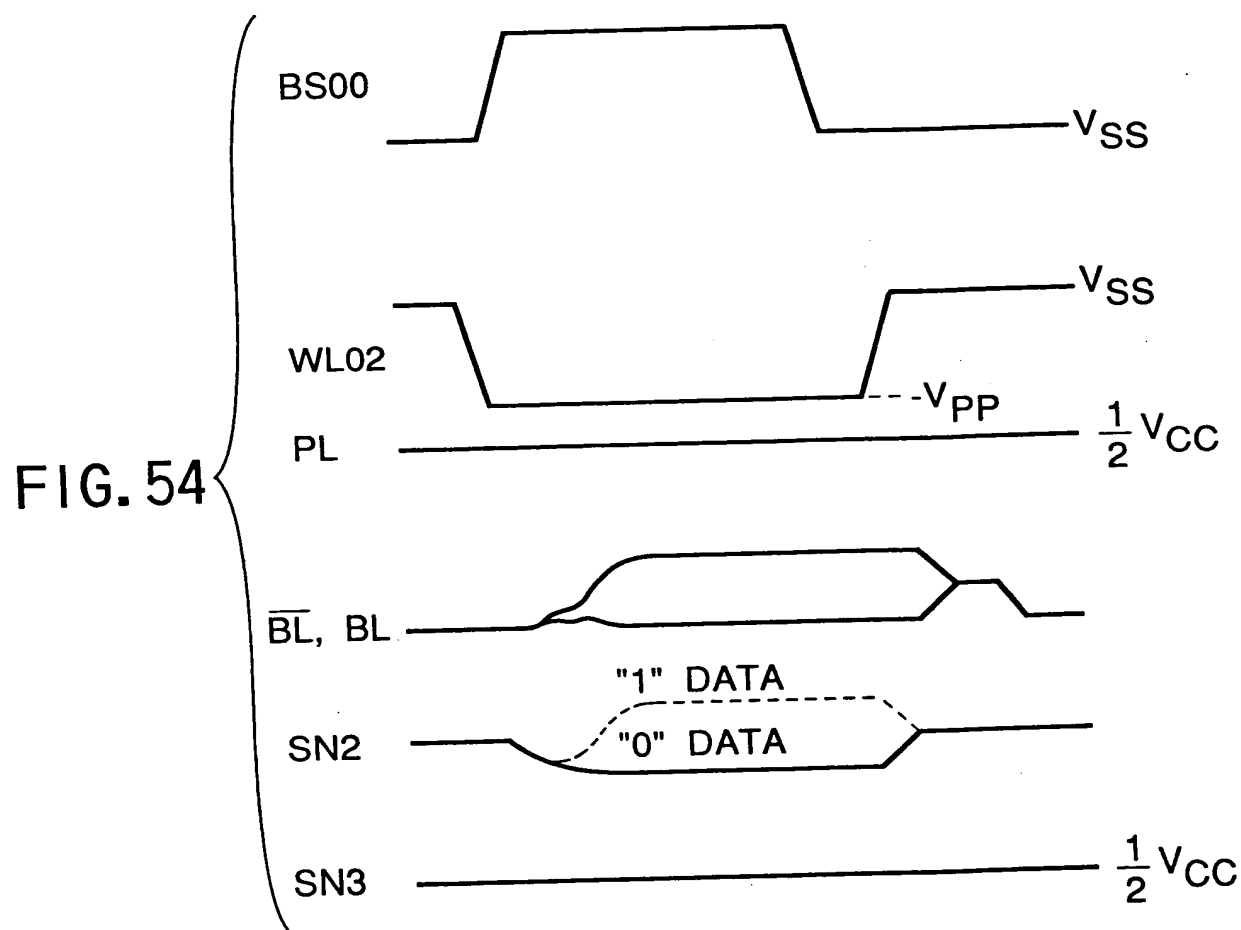


FIG. 53



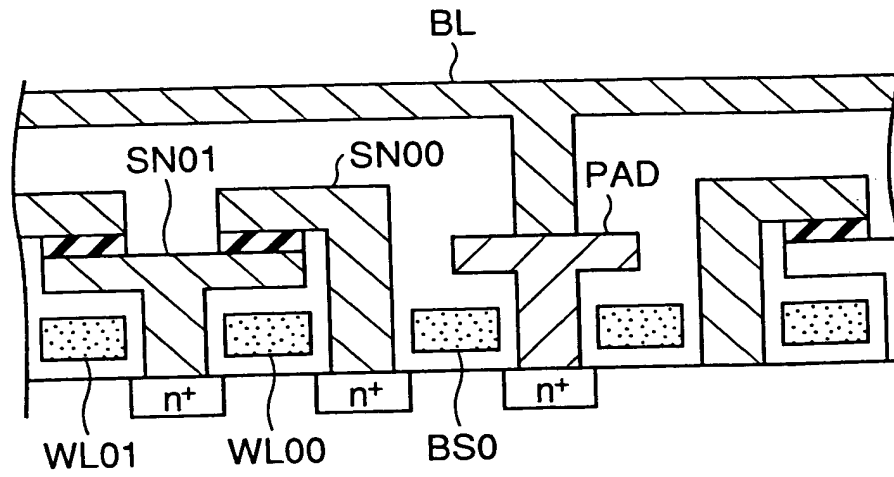


FIG. 55A

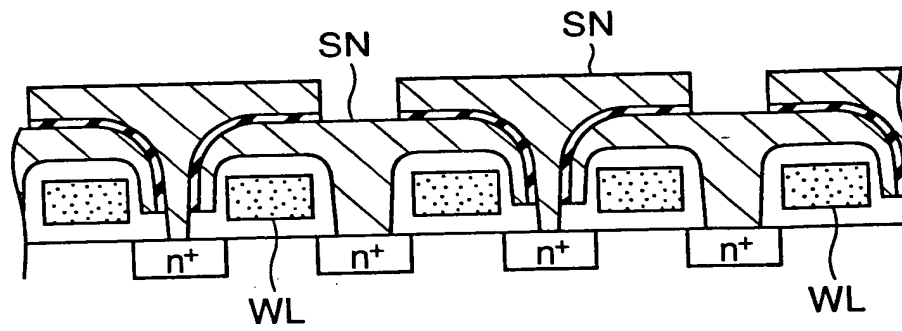


FIG. 55B

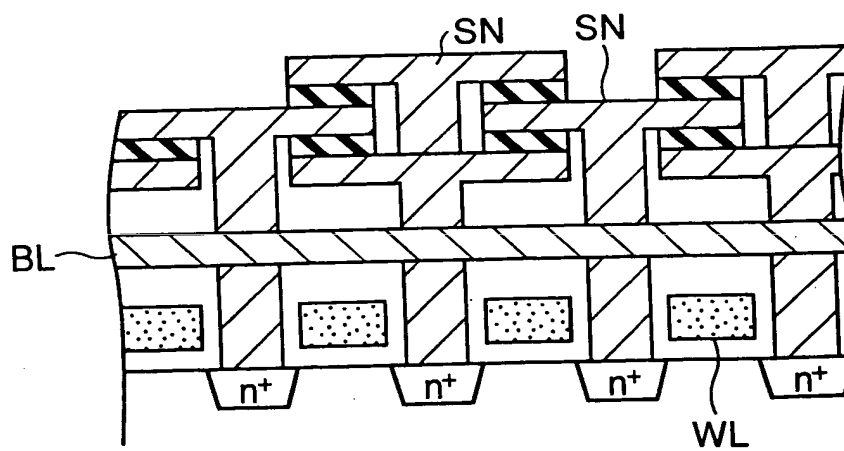


FIG. 55C

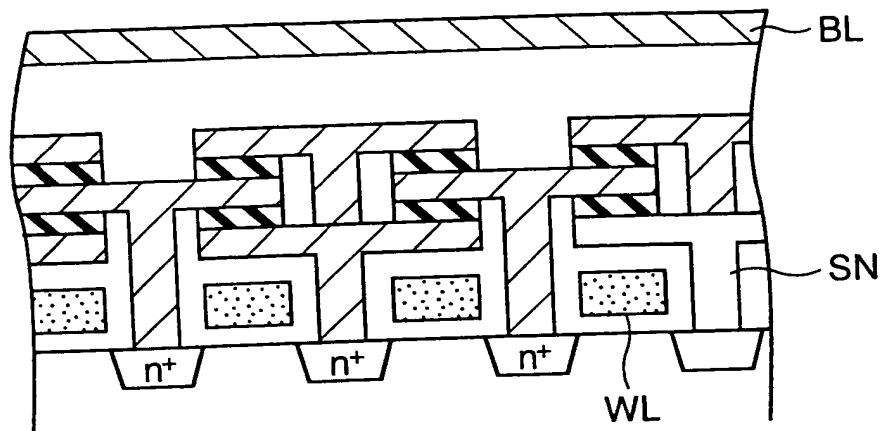


FIG. 55D

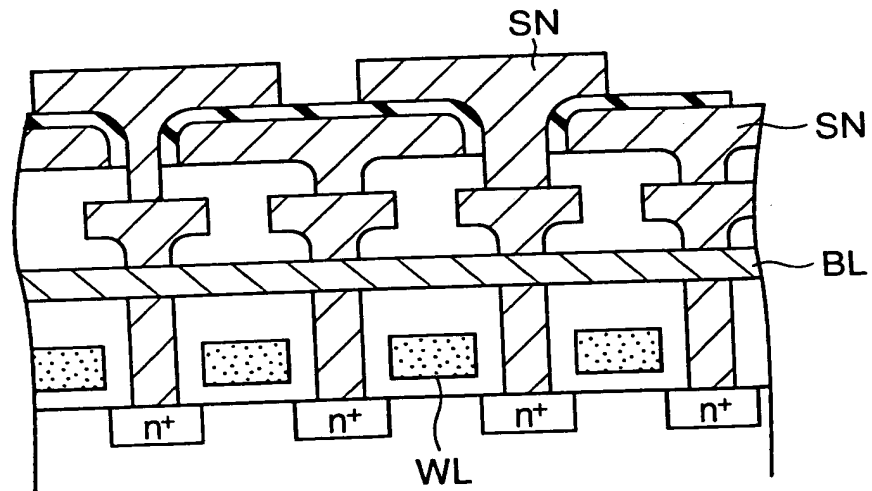


FIG. 55E

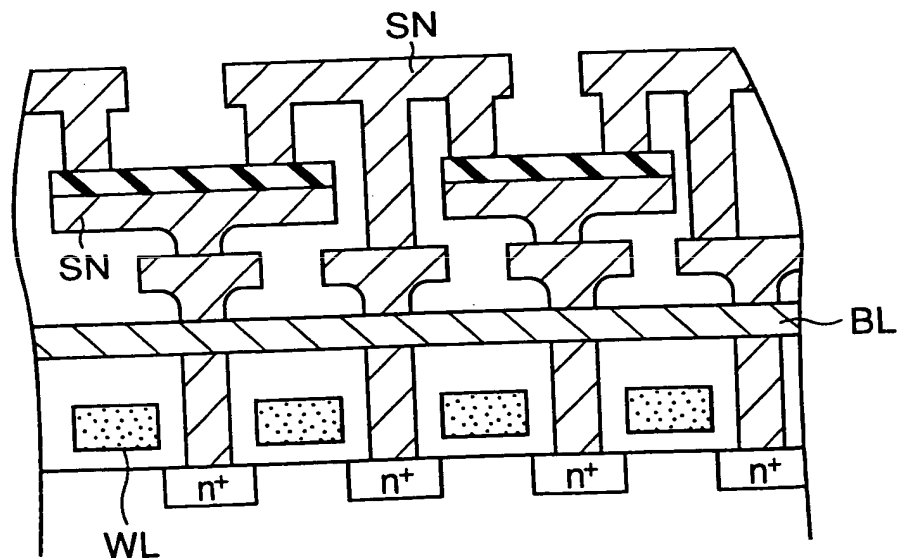


FIG. 55F

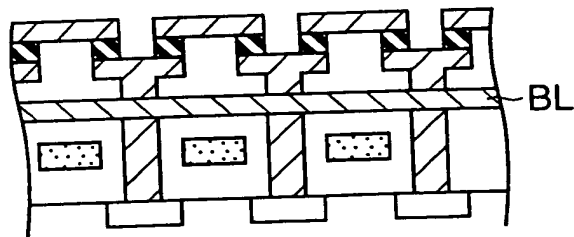


FIG. 55G

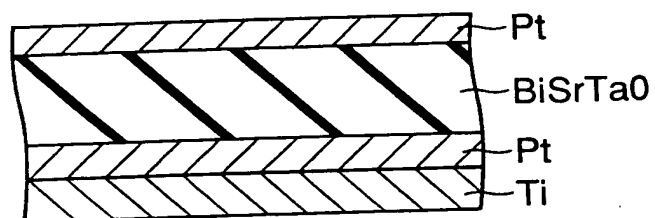


FIG. 55H

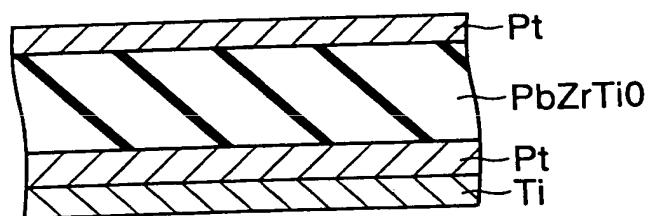


FIG. 55I

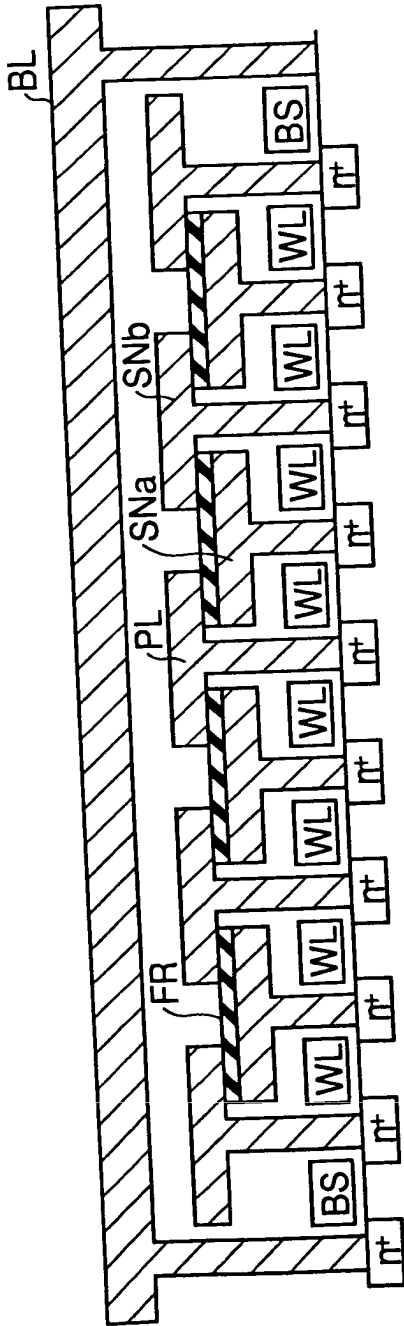


FIG. 56

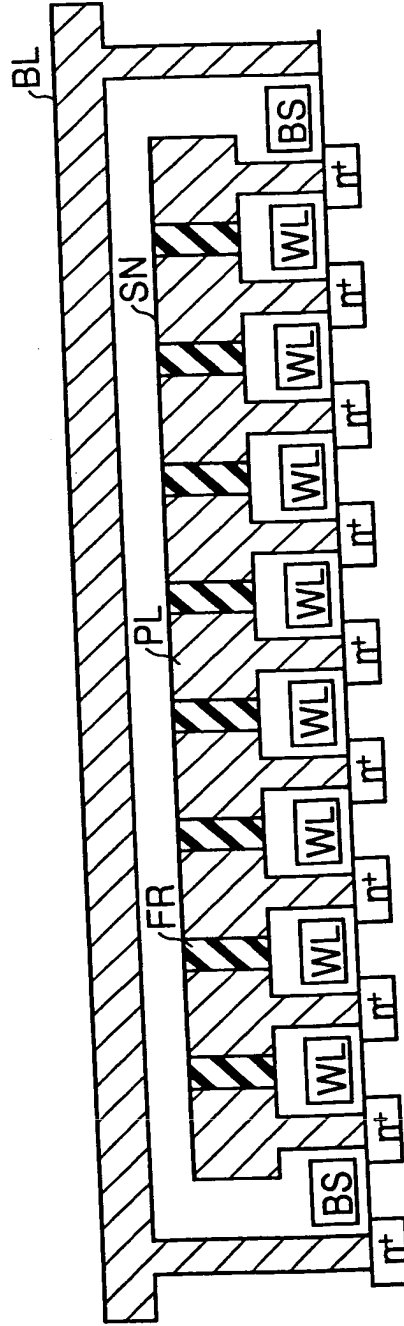


FIG. 58

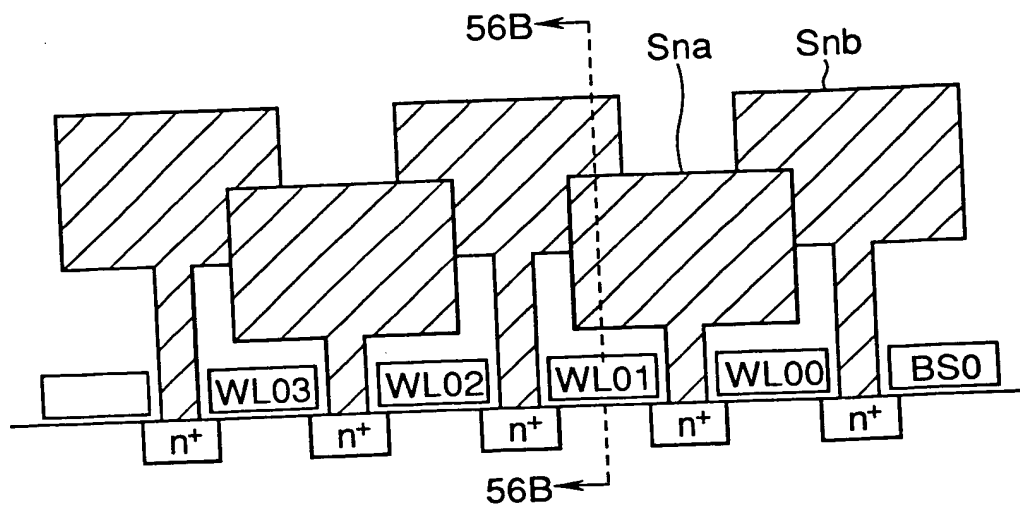
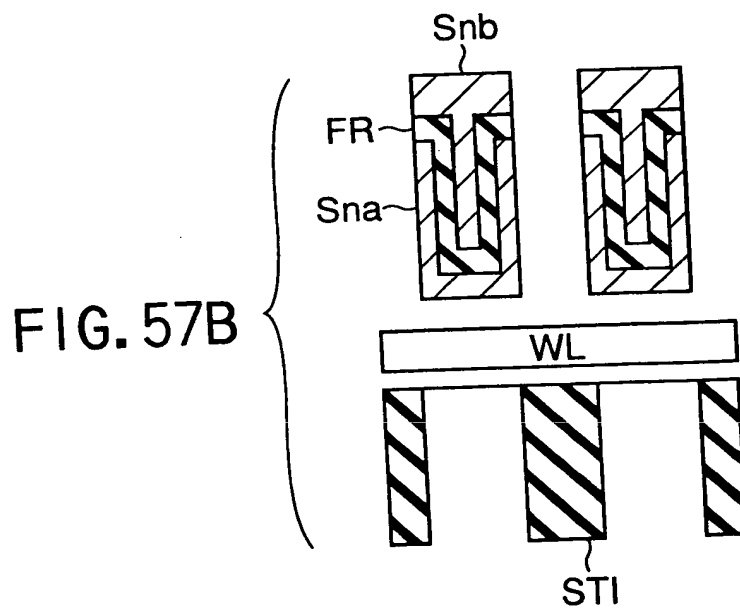
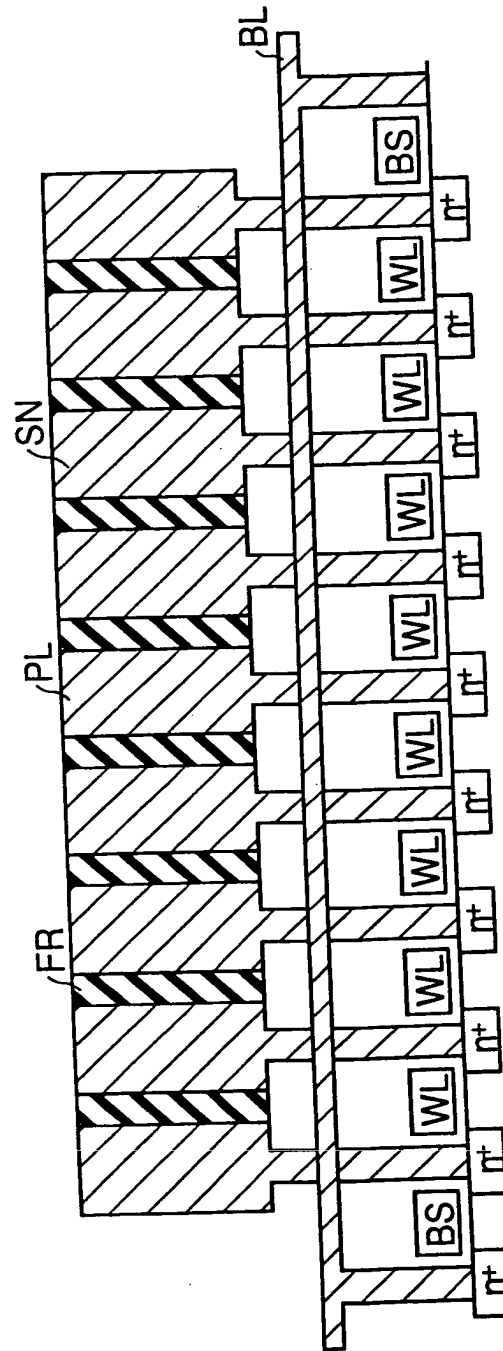
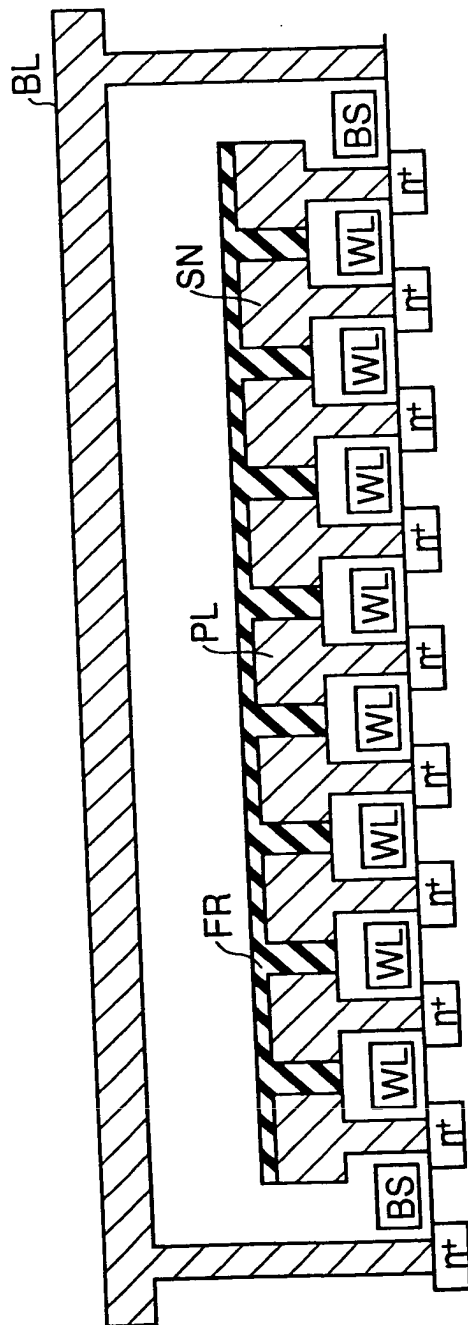


FIG. 57A





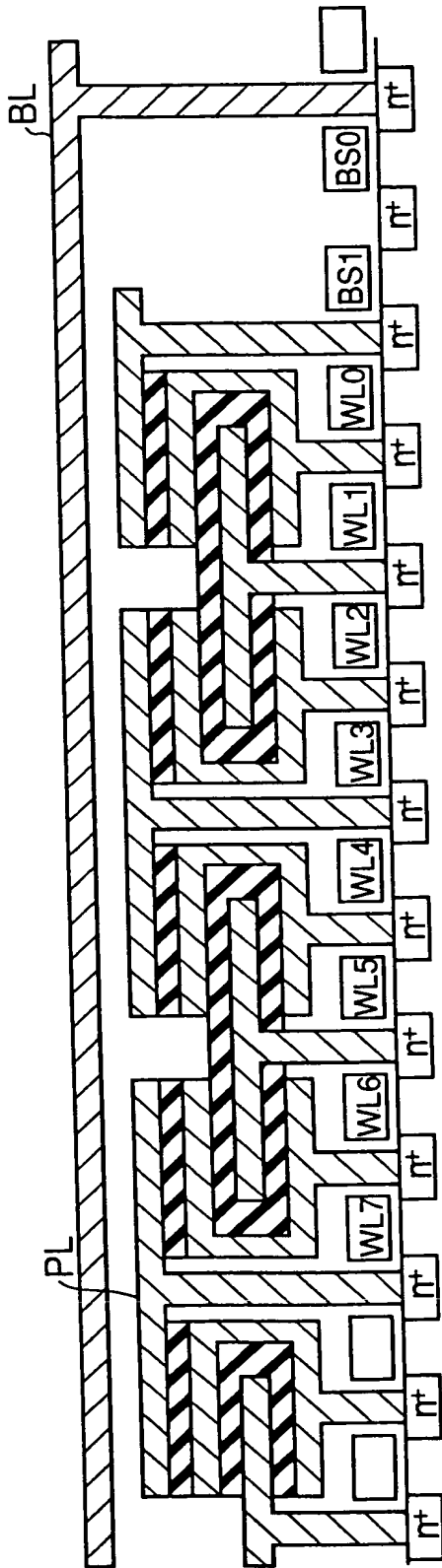


FIG. 61

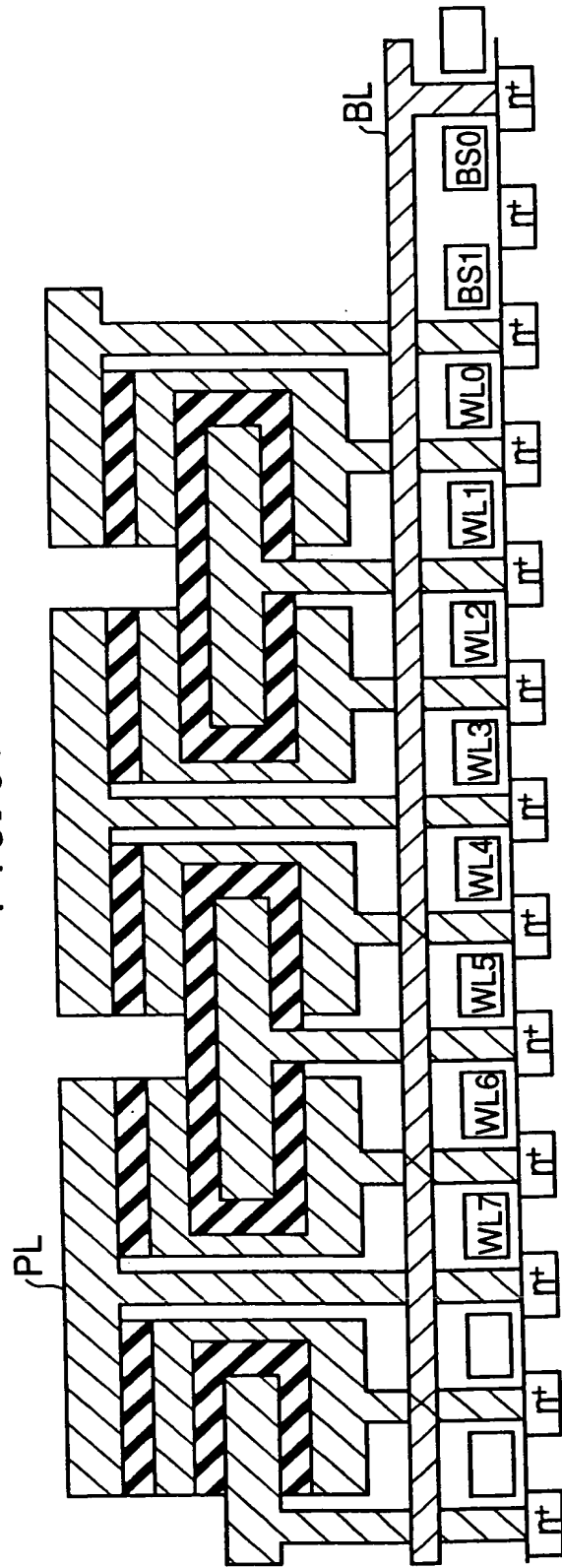


FIG. 62

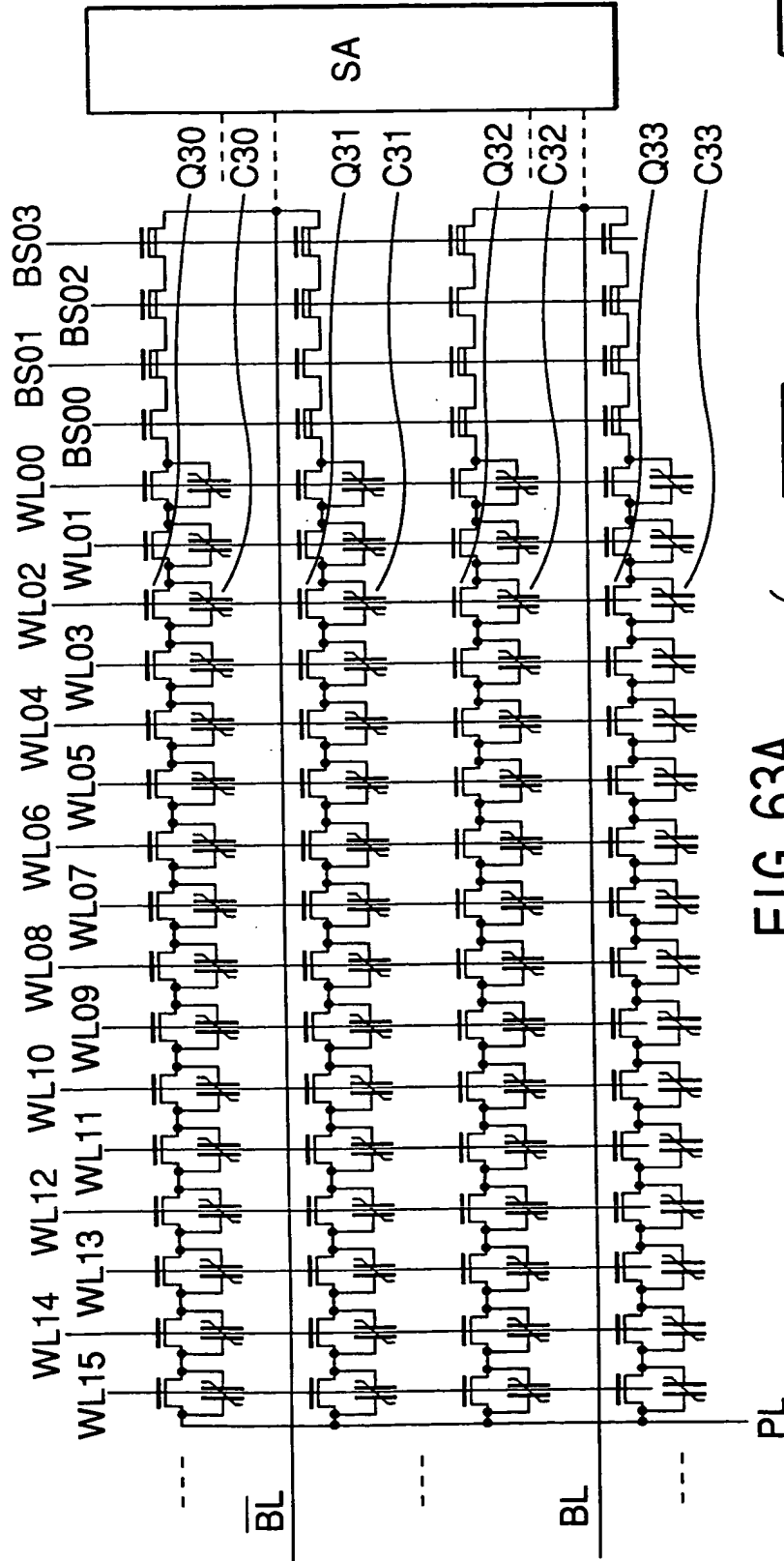


FIG. 63A

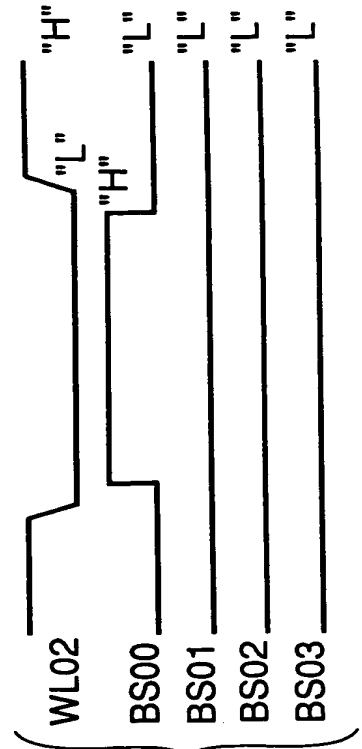


FIG. 63B

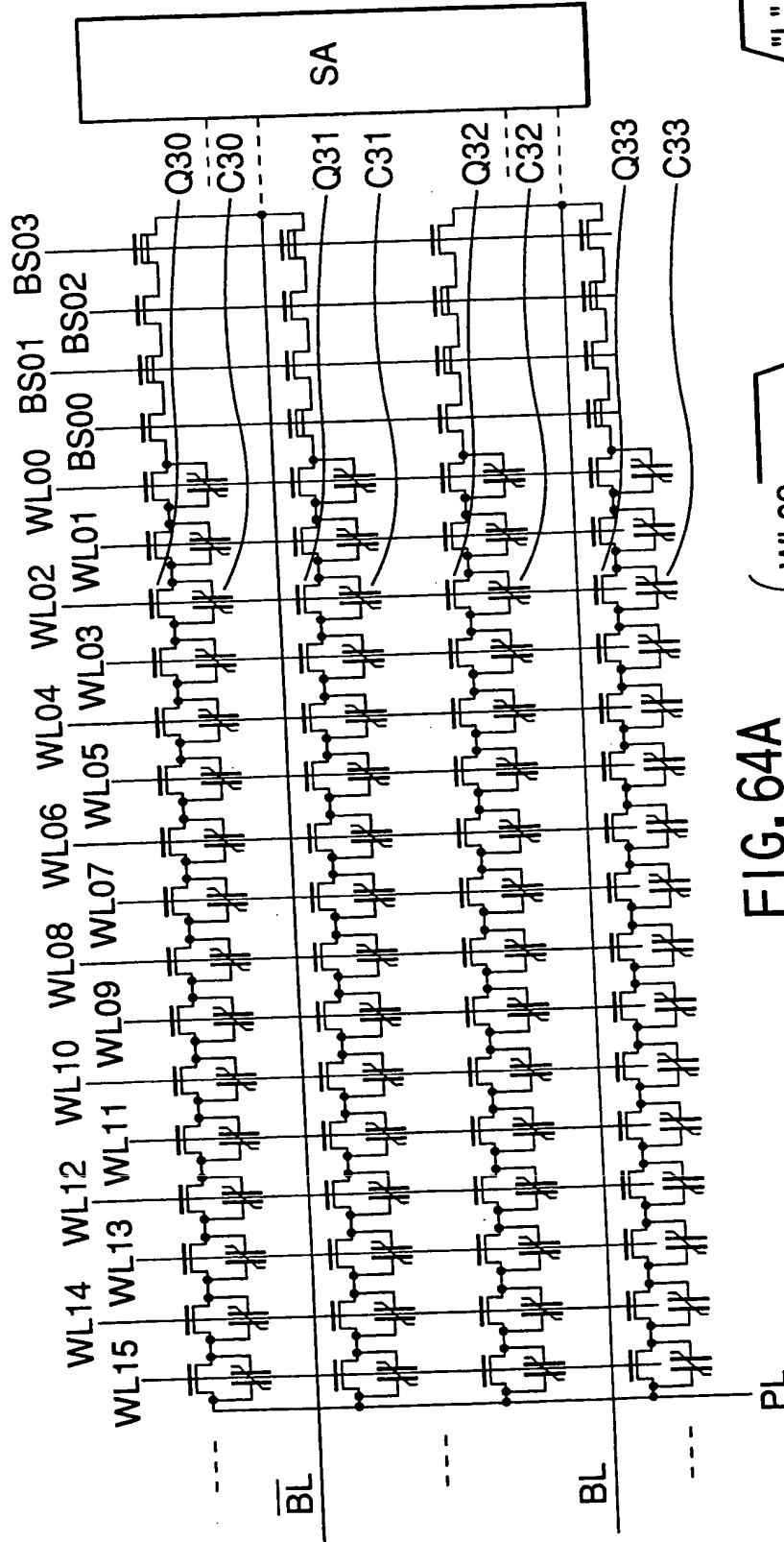


FIG. 64A

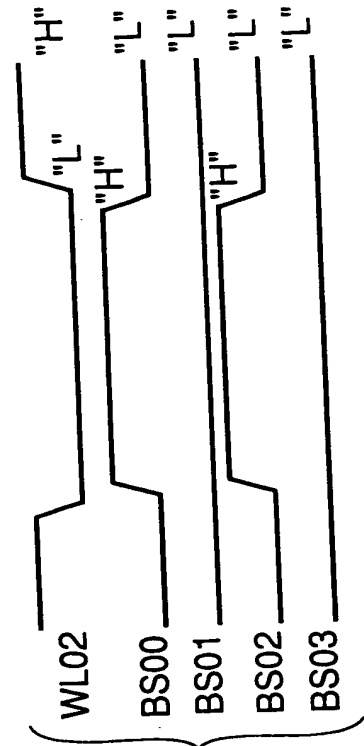


FIG. 64B

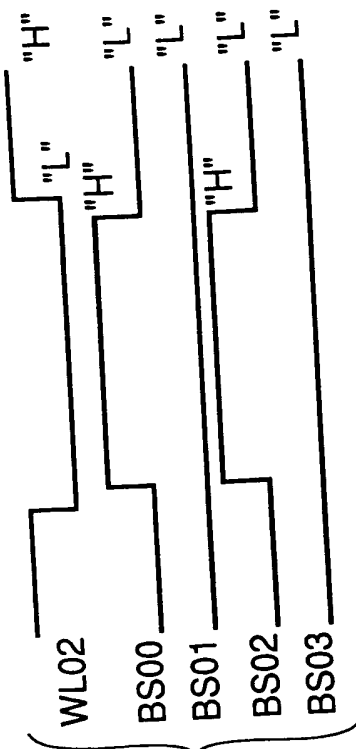
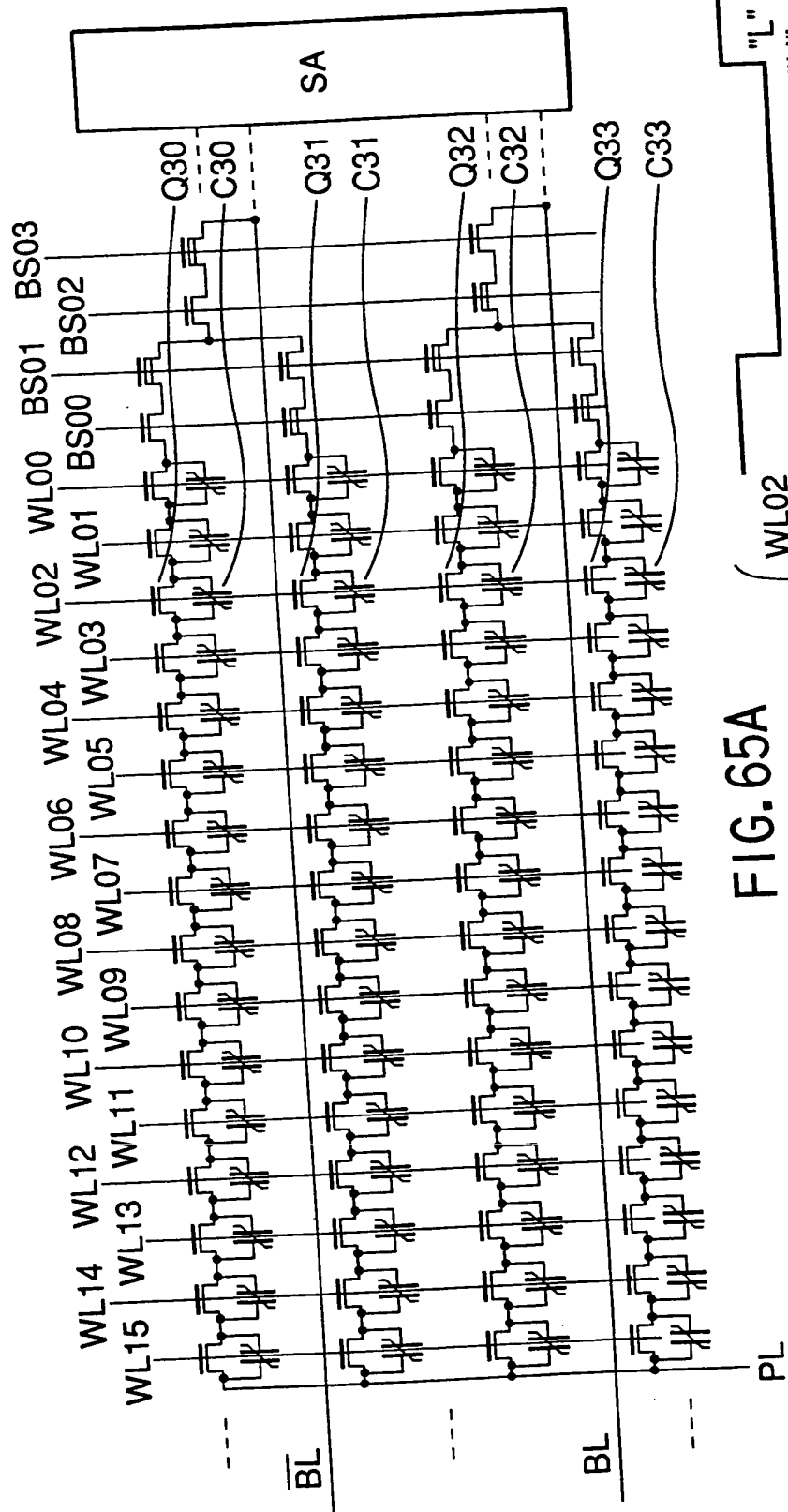


FIG. 65A

FIG. 65B

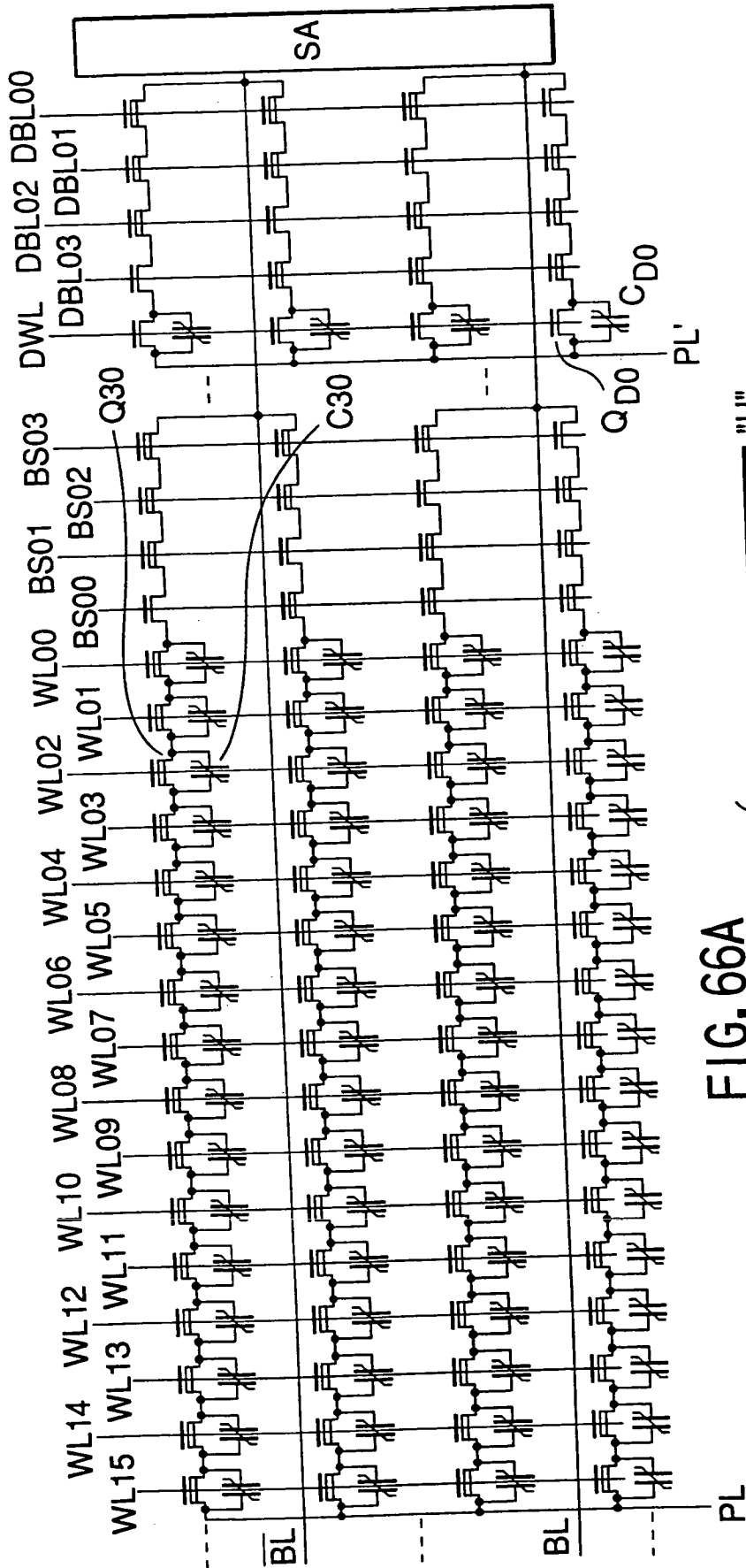


FIG. 66A

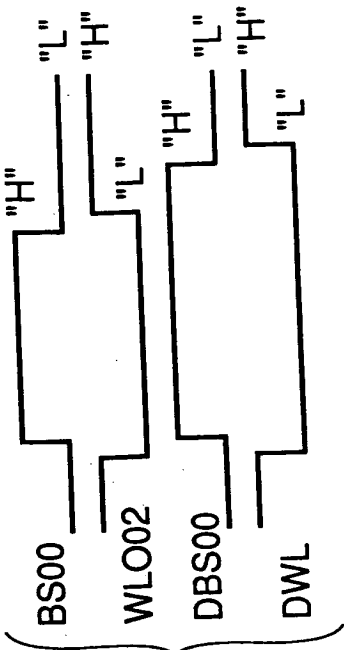


FIG. 66B

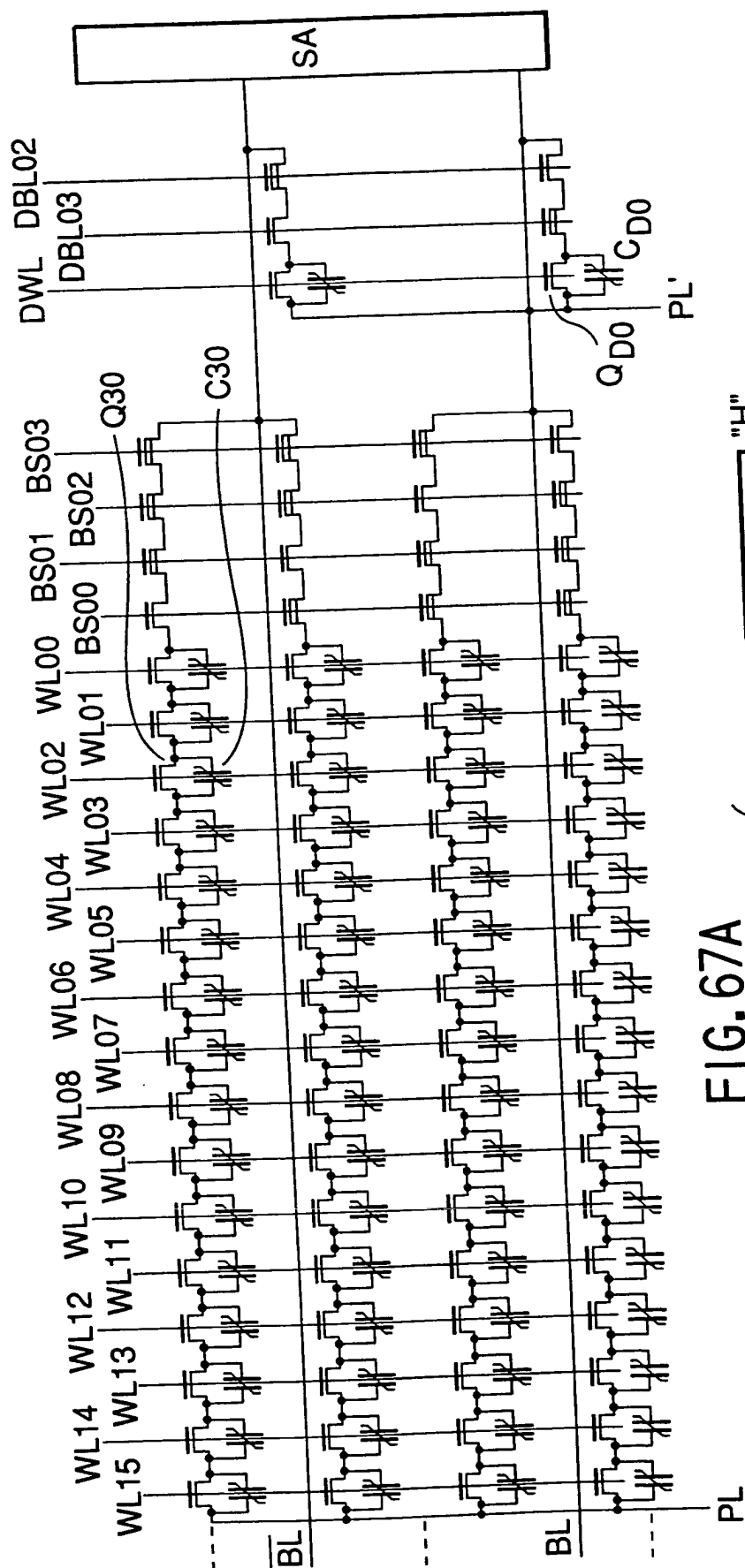


FIG. 67A

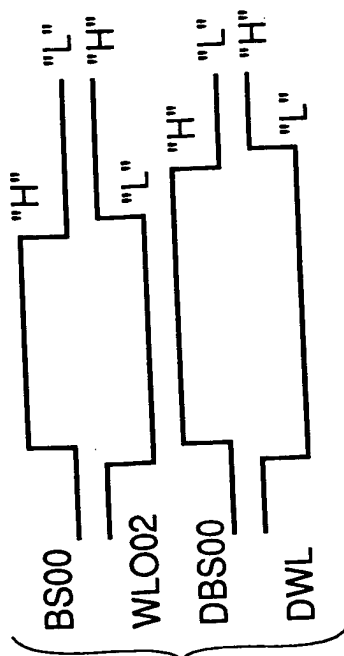


FIG. 67B

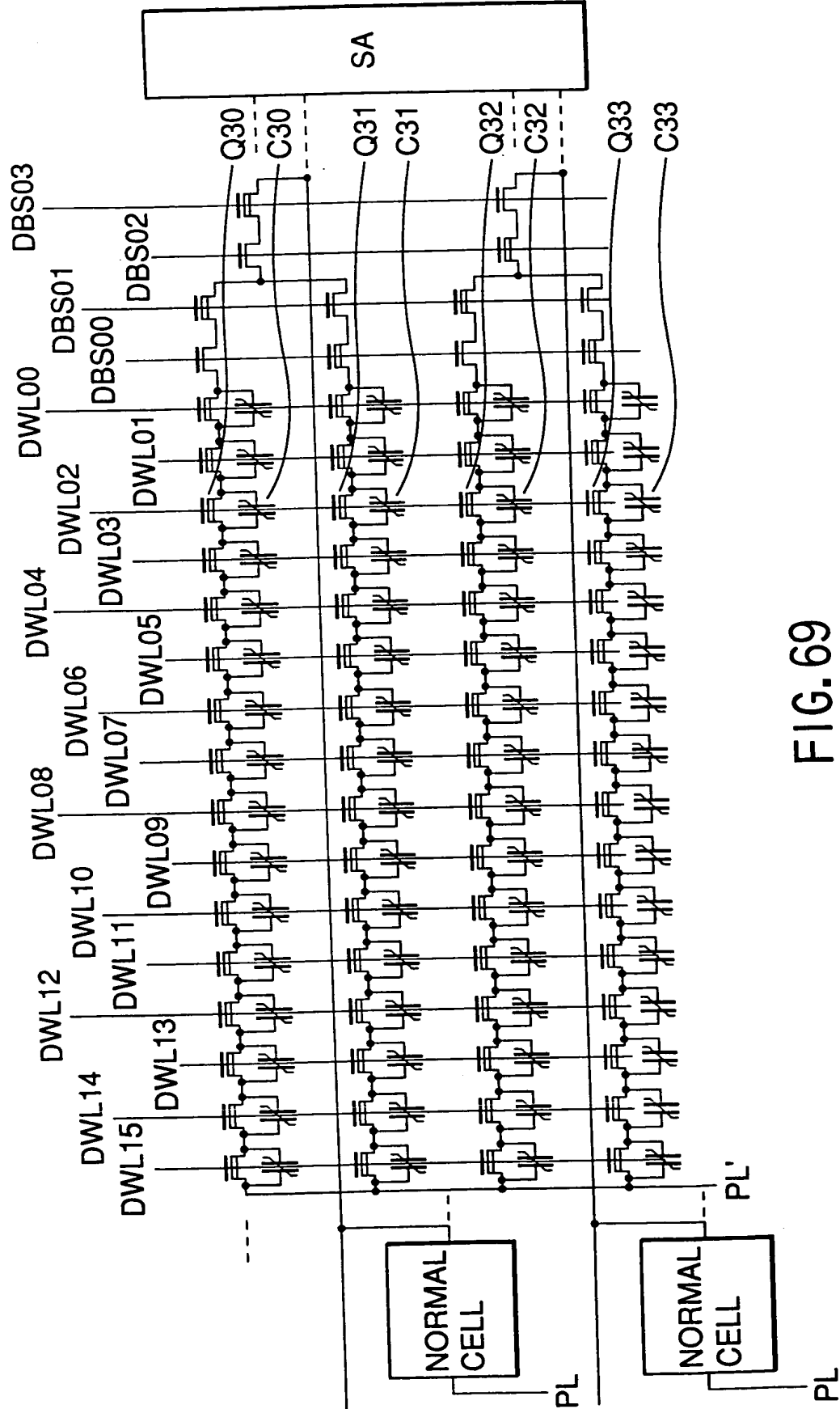
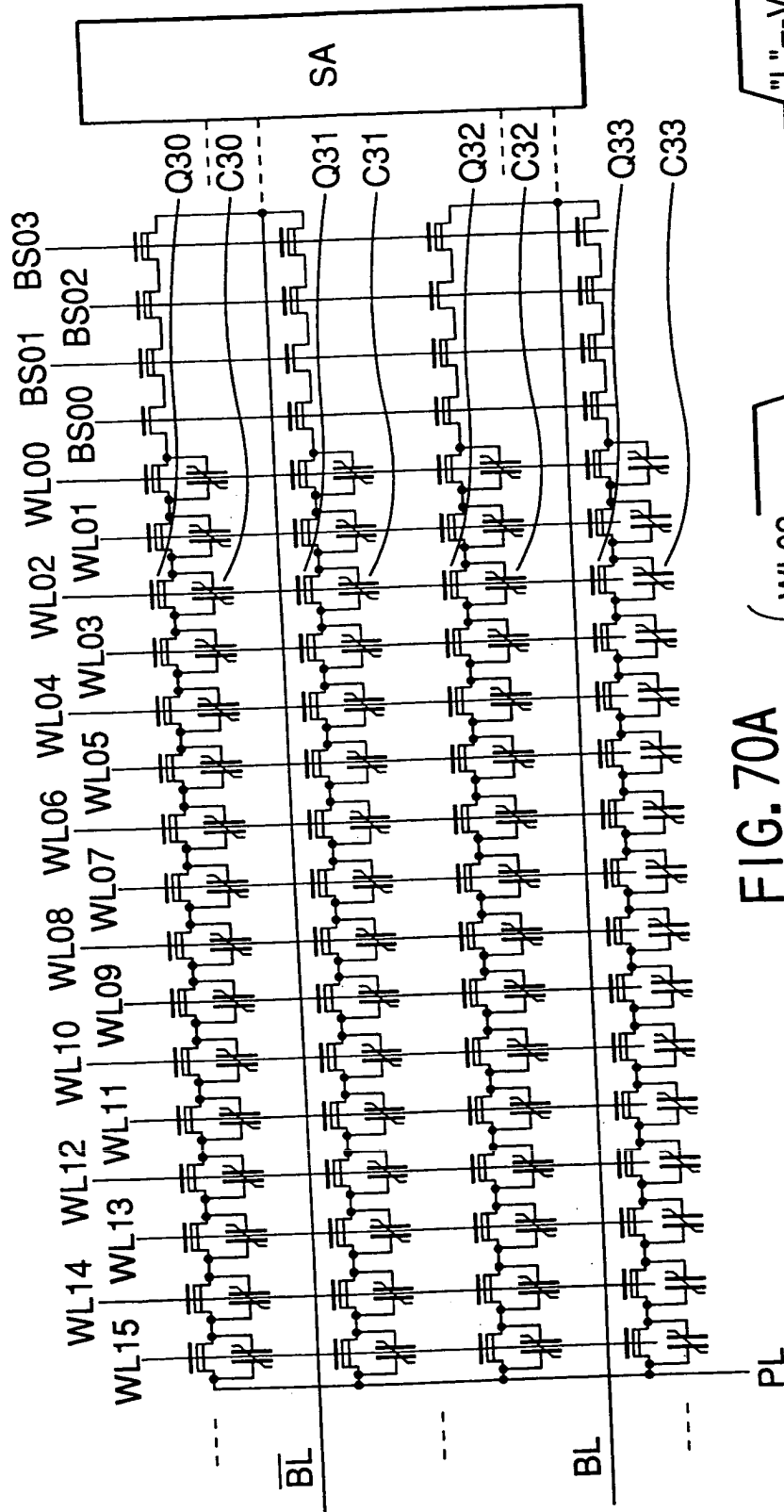
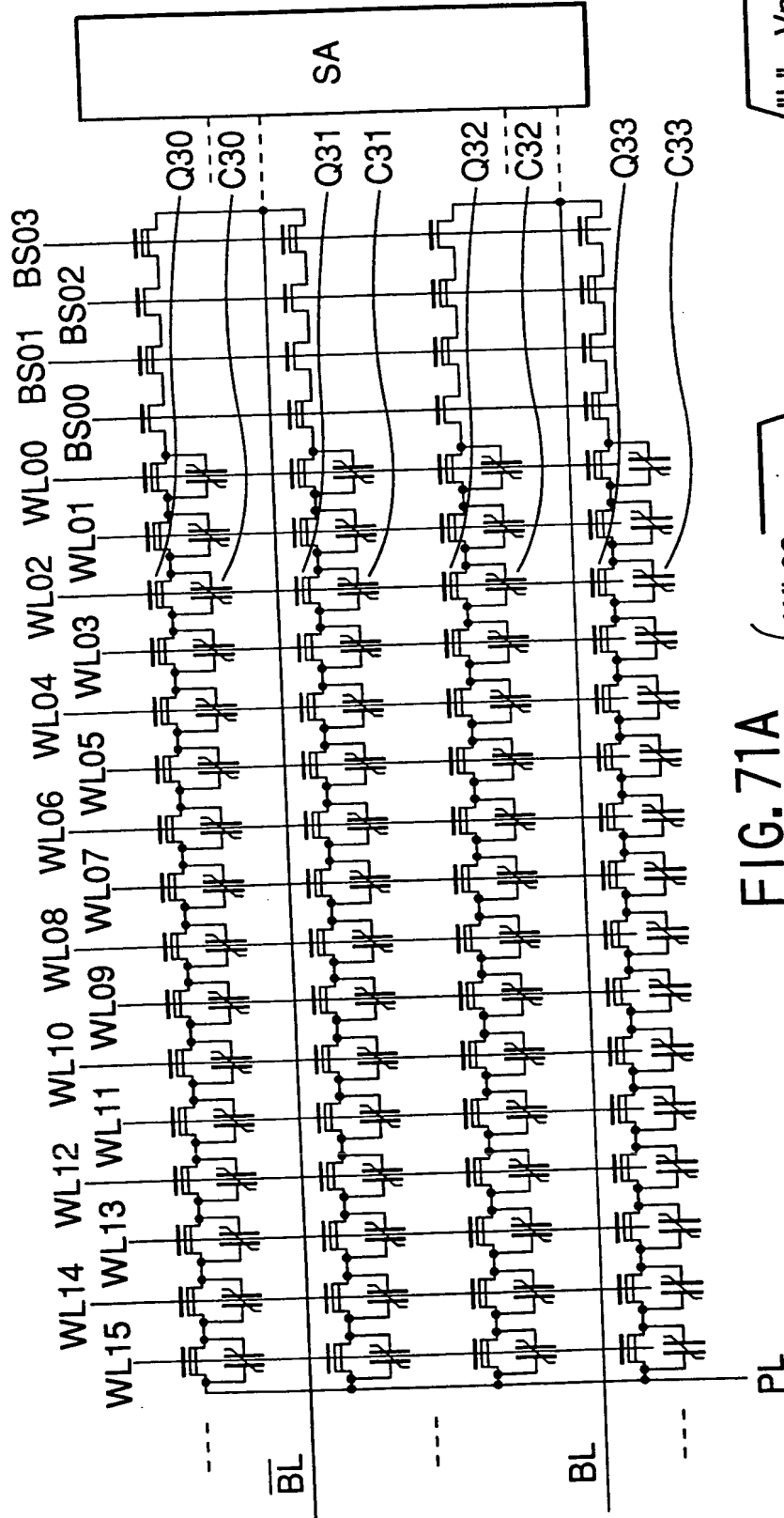


FIG. 69

FIG. 70B





"H"=OV

FIG. 71A

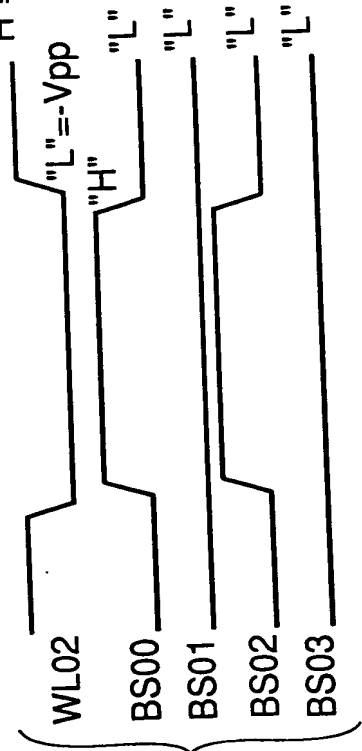


FIG. 71B

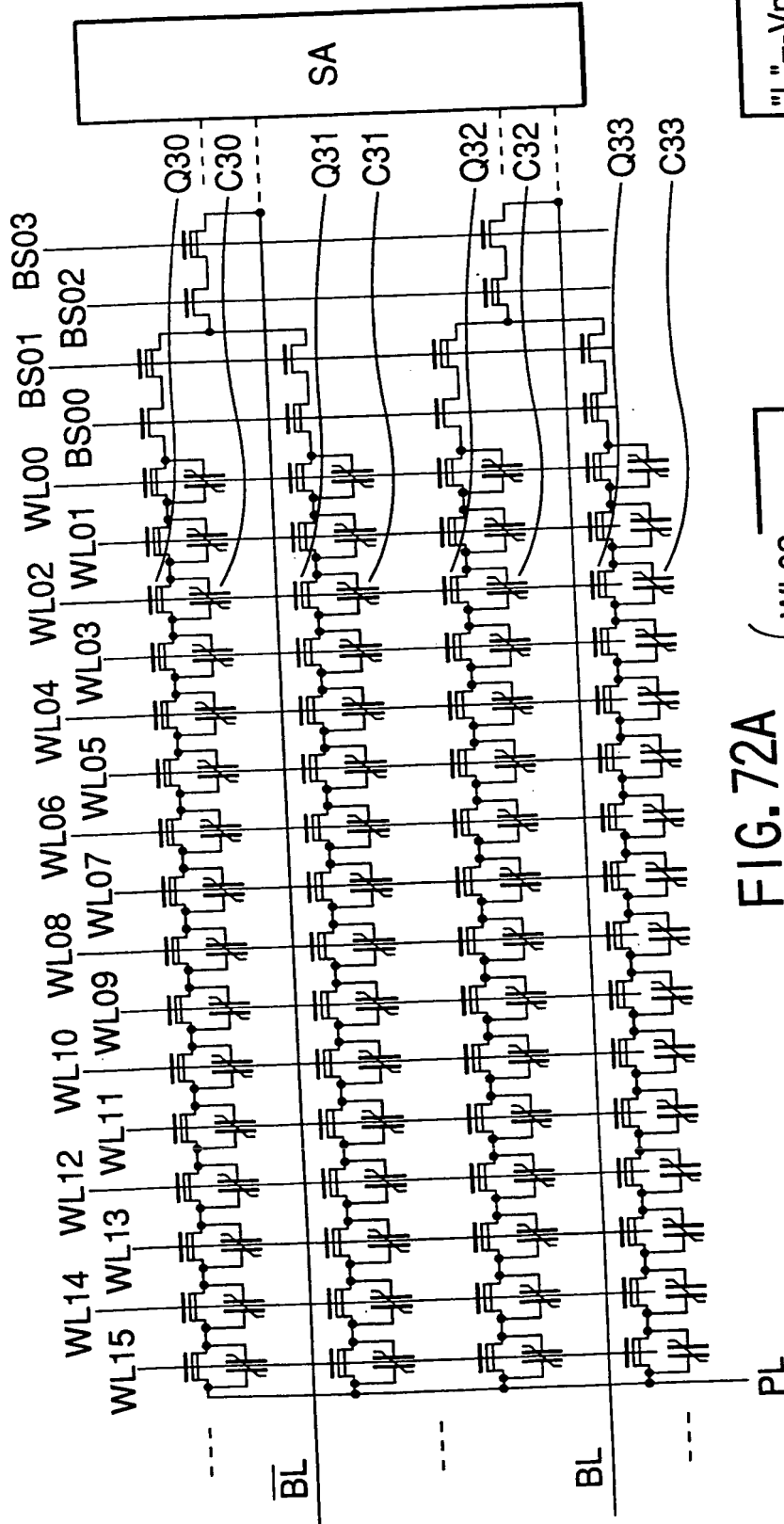


FIG. 72A

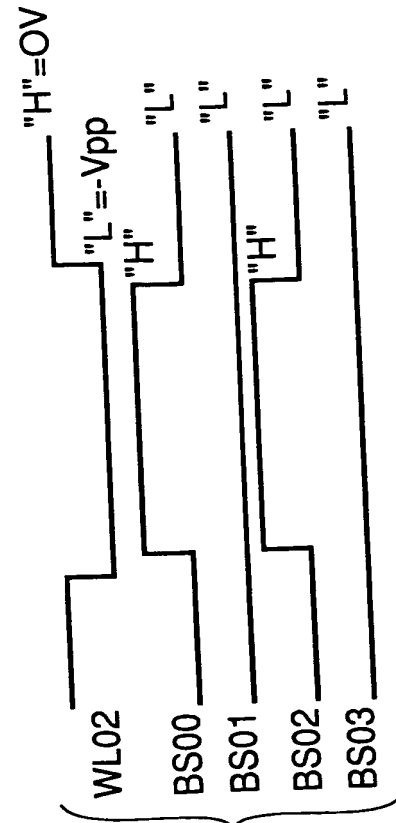


FIG. 72B

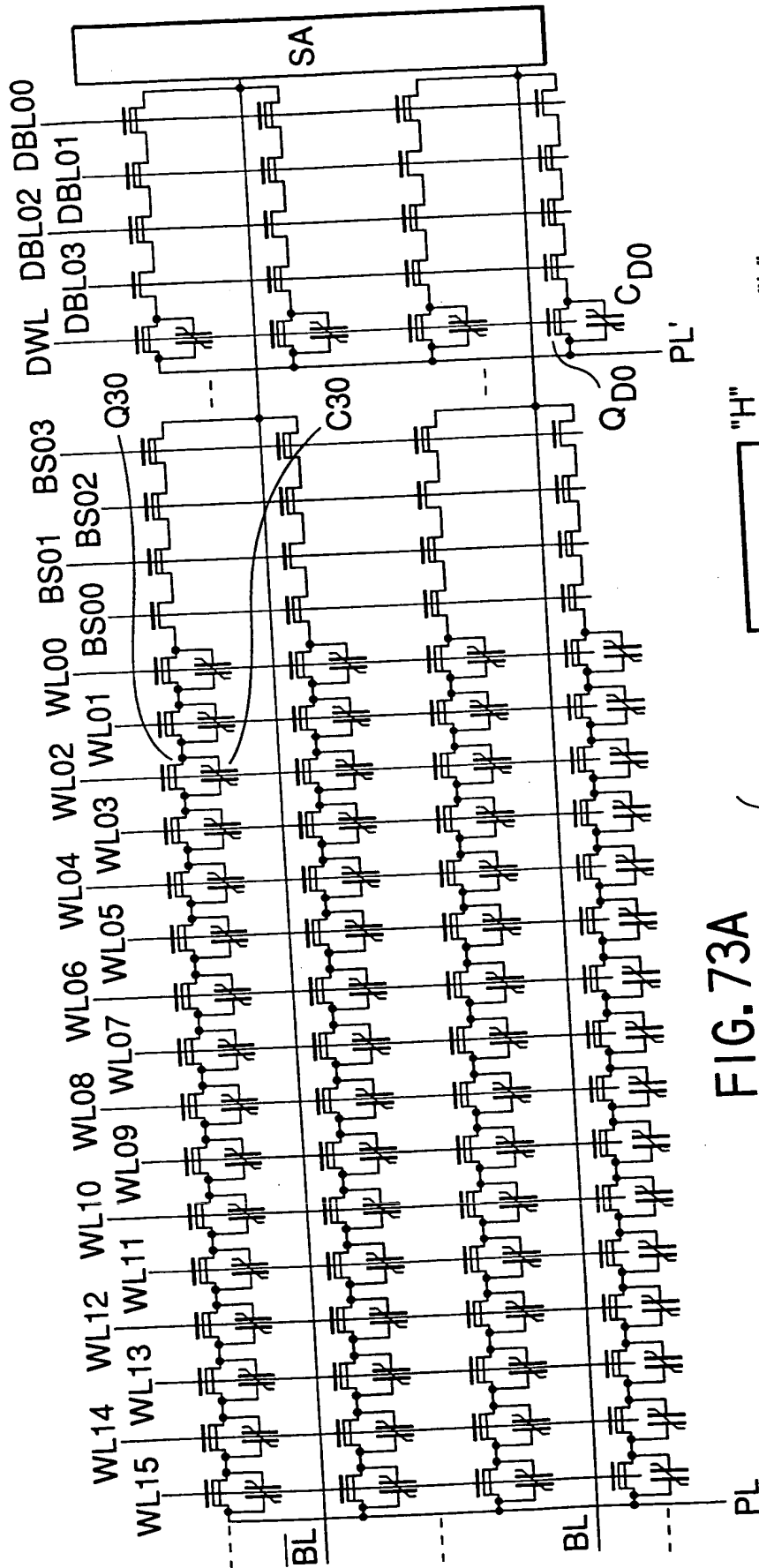


FIG. 73A

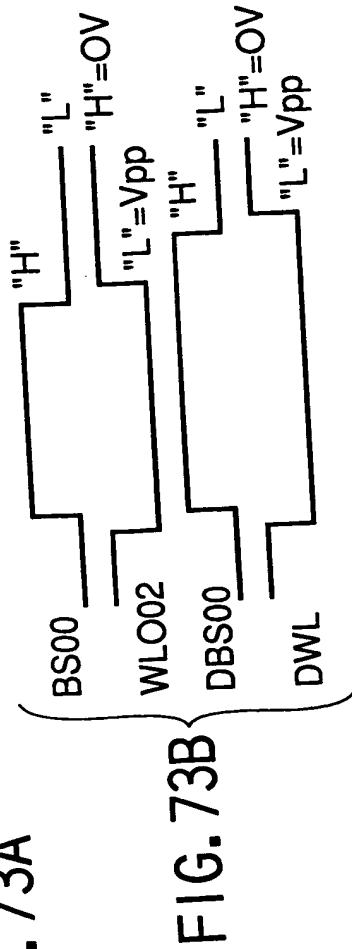


FIG. 73B

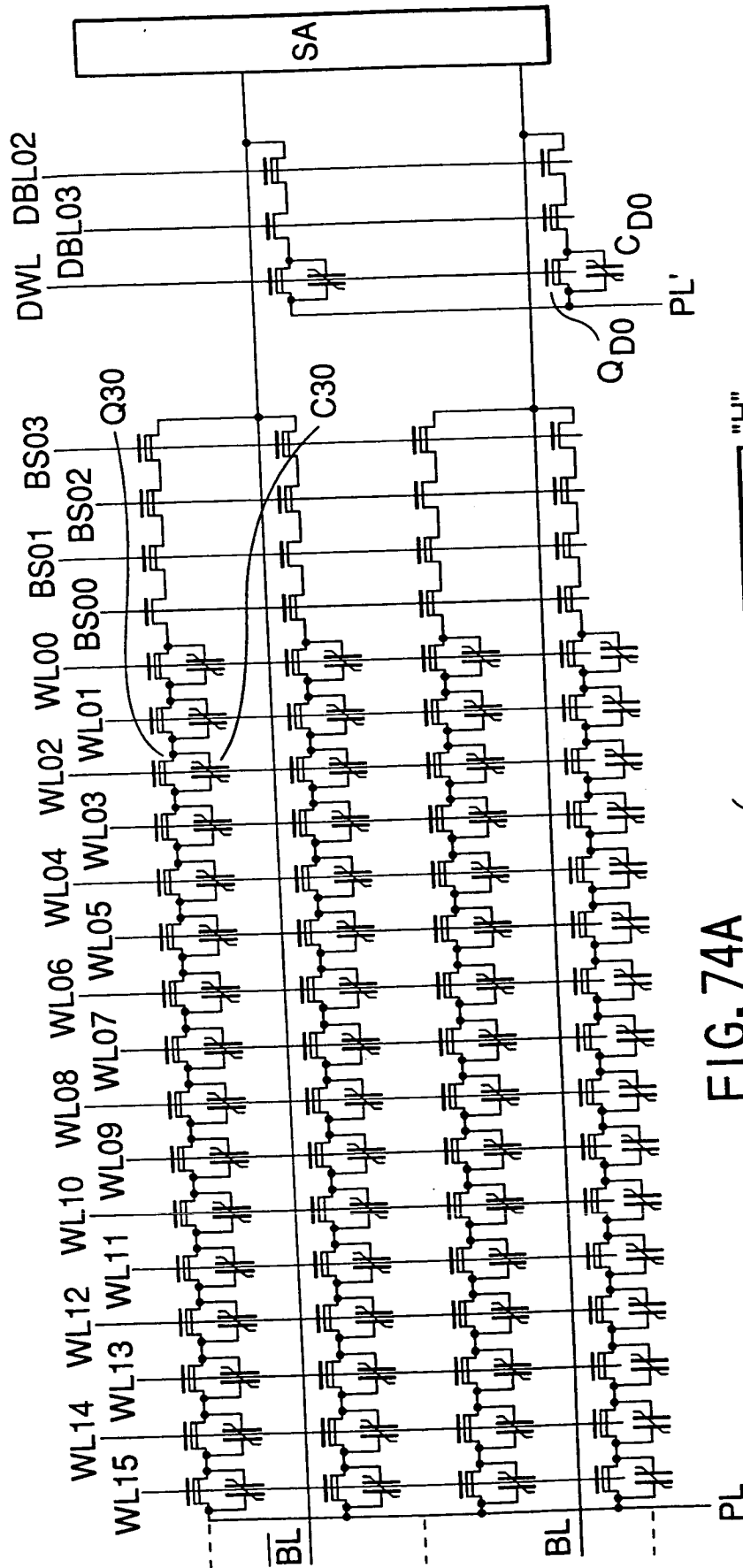


FIG. 74A

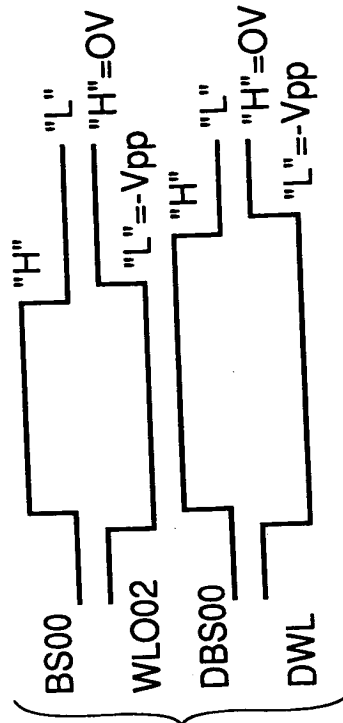


FIG. 74B

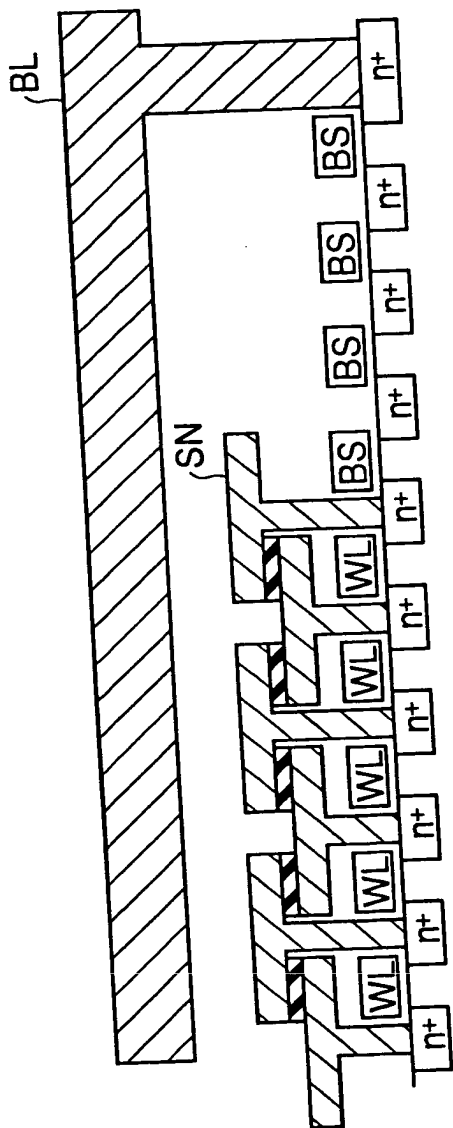


FIG. 75A

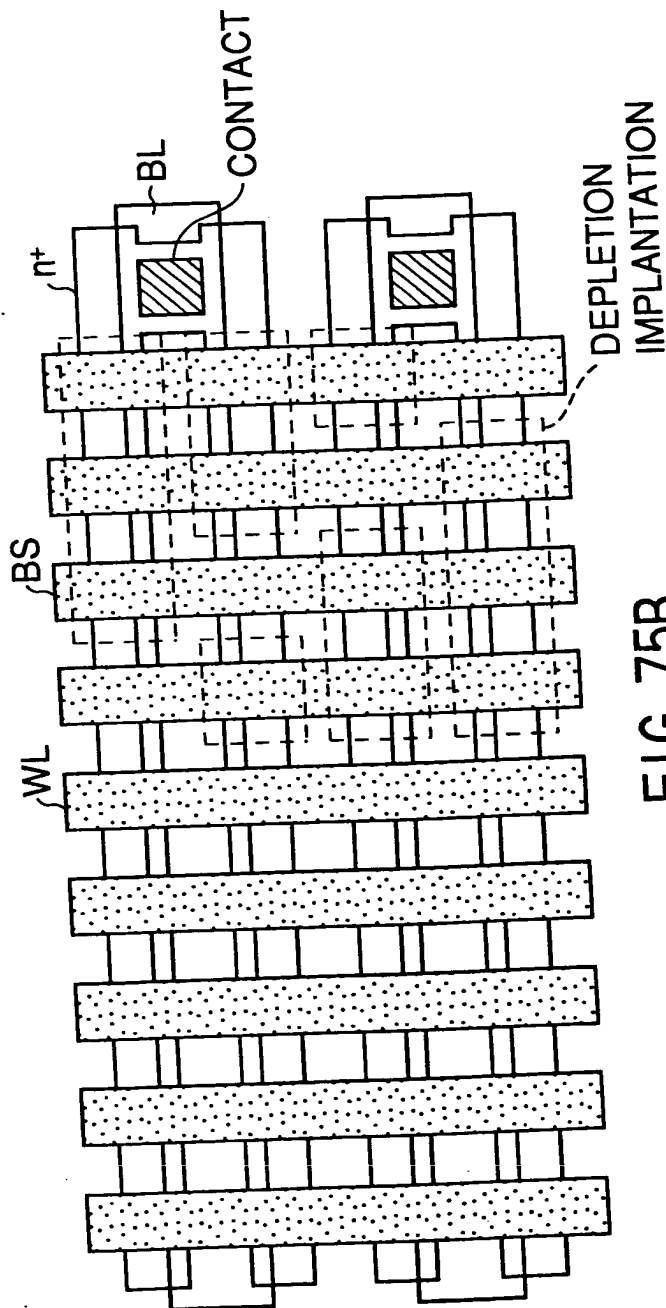


FIG. 75B

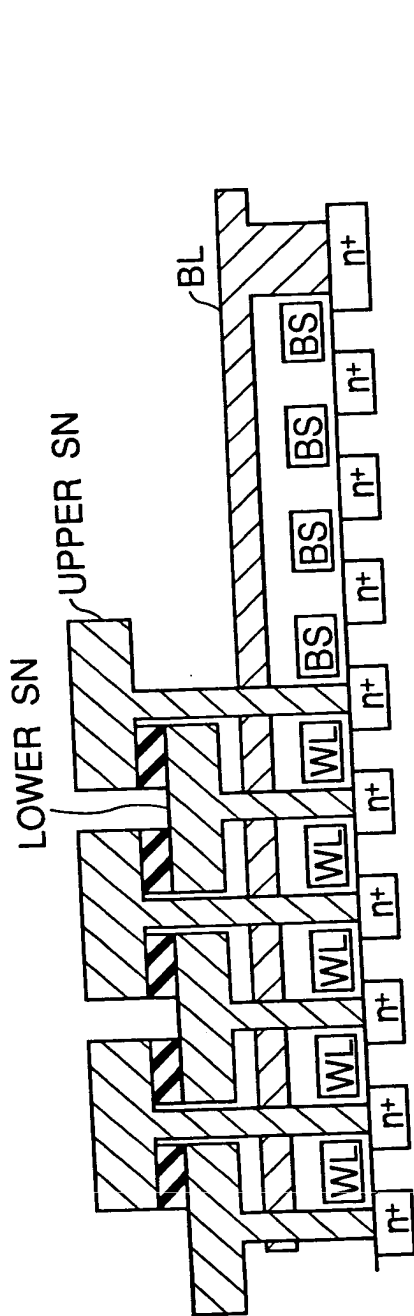


FIG. 76A

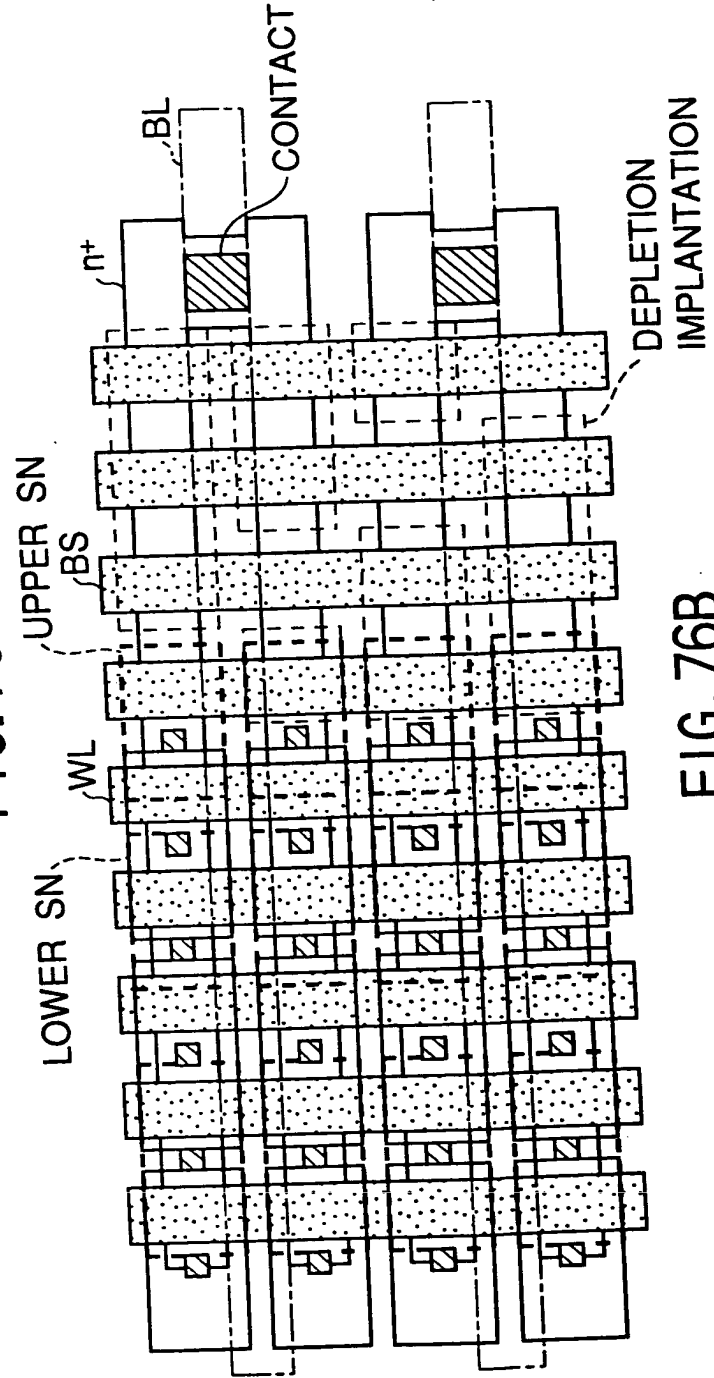


FIG. 76B

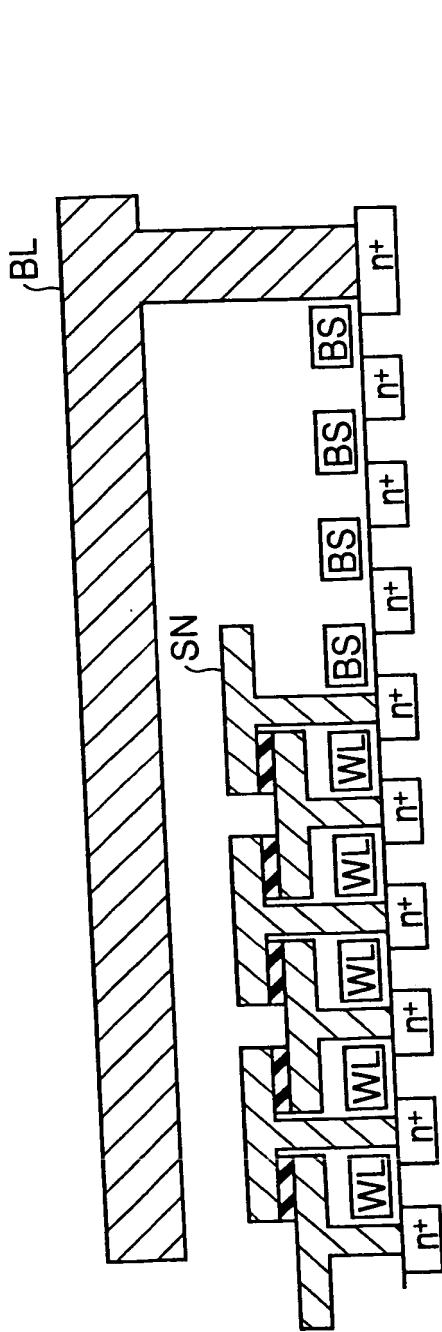


FIG. 77A

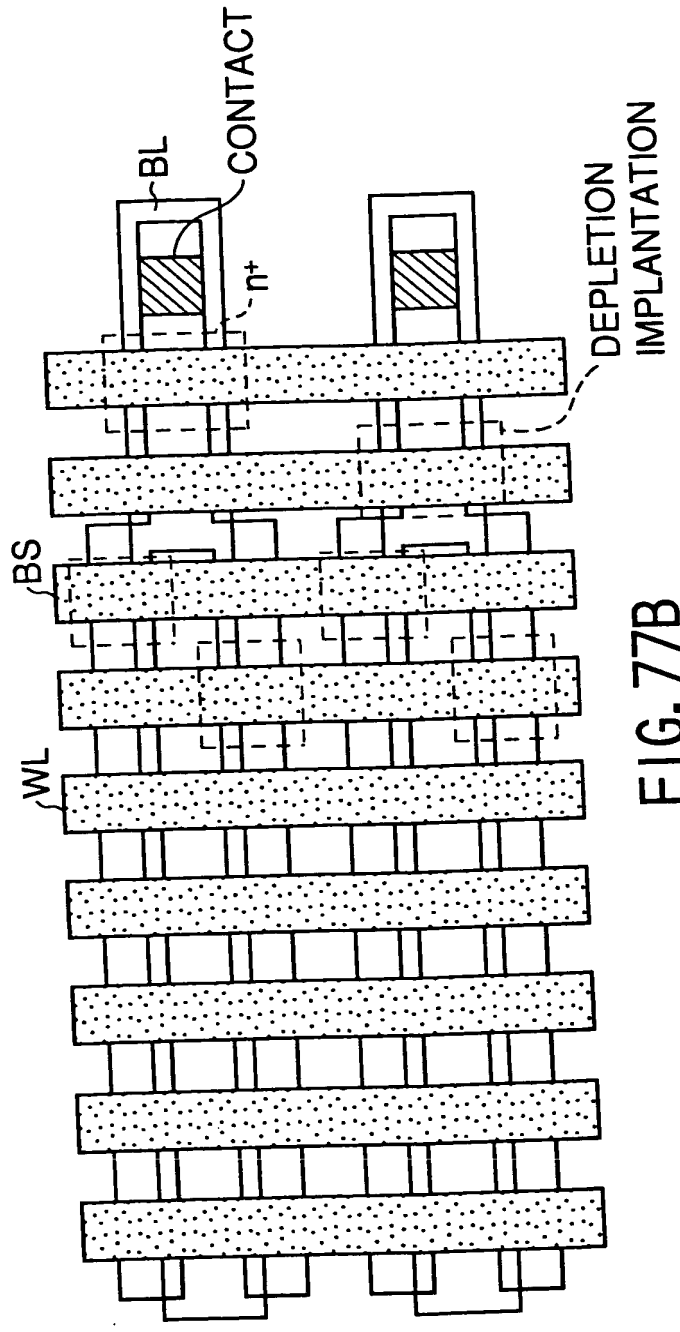


FIG. 77B

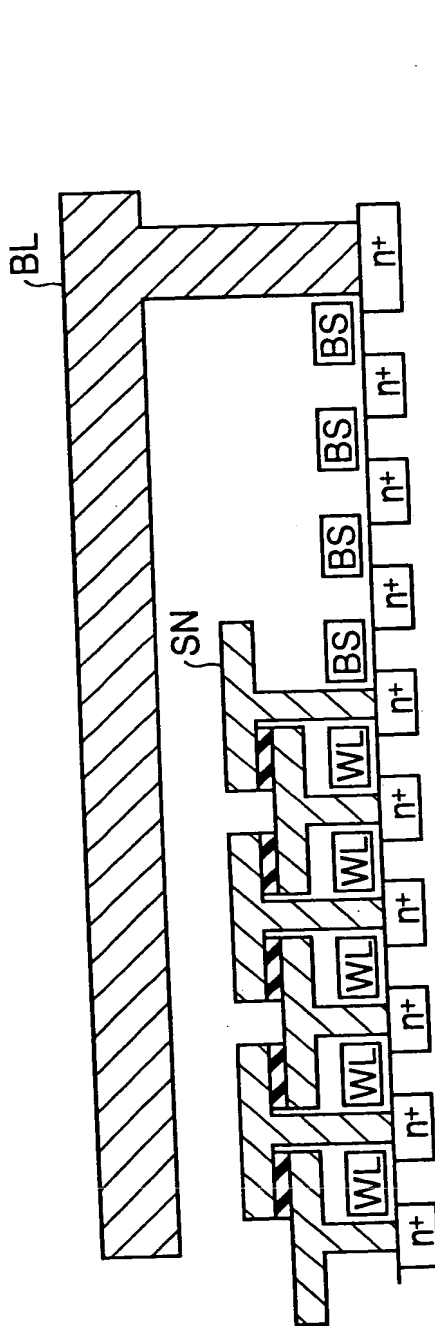


FIG. 78A

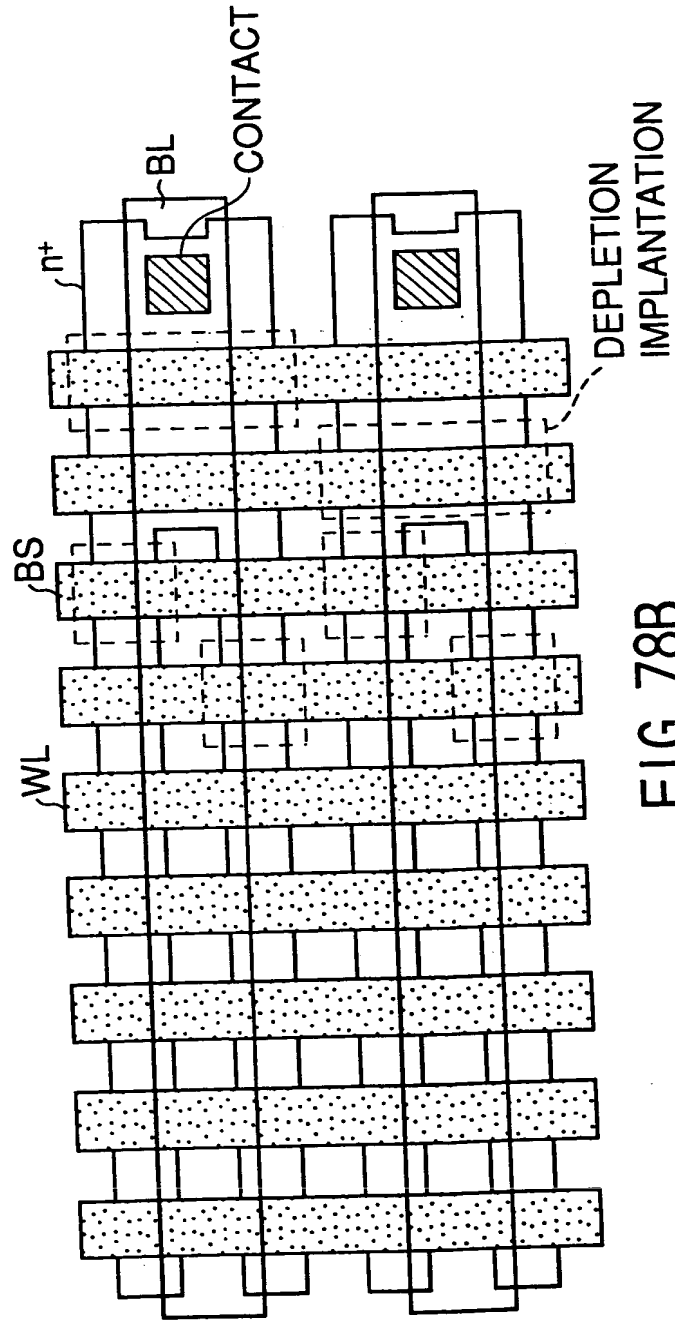
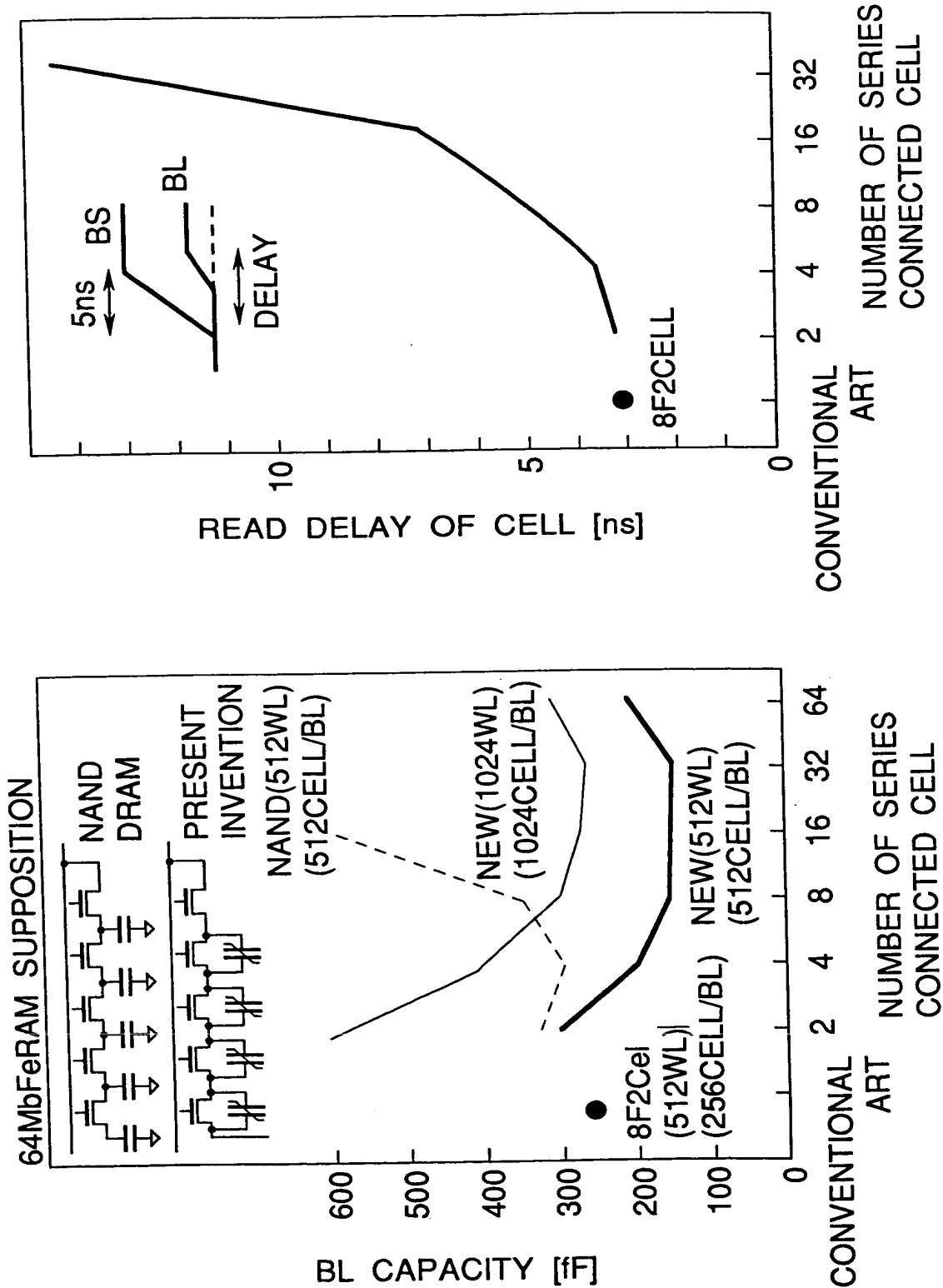


FIG. 78B



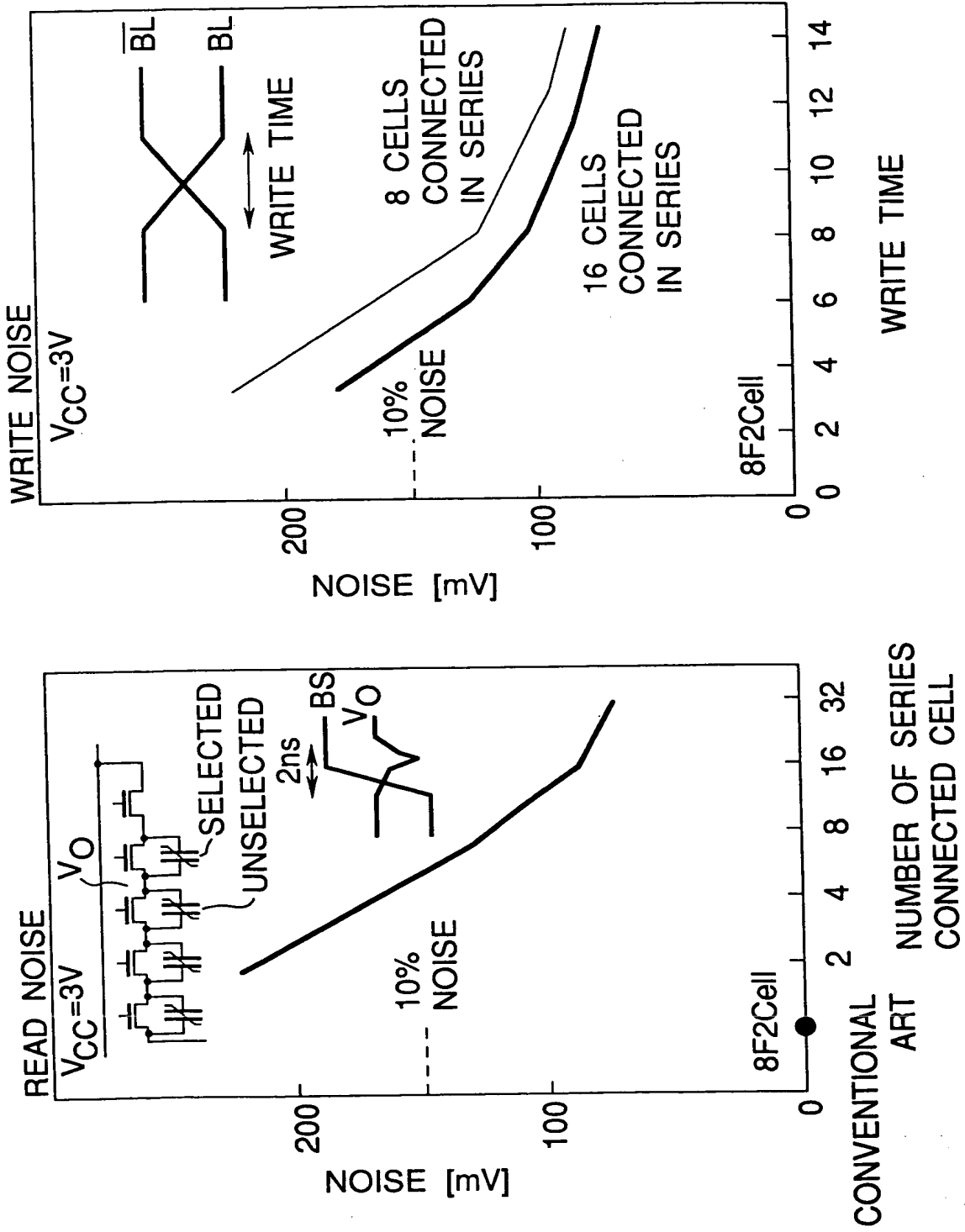


FIG. 80A

FIG. 80B

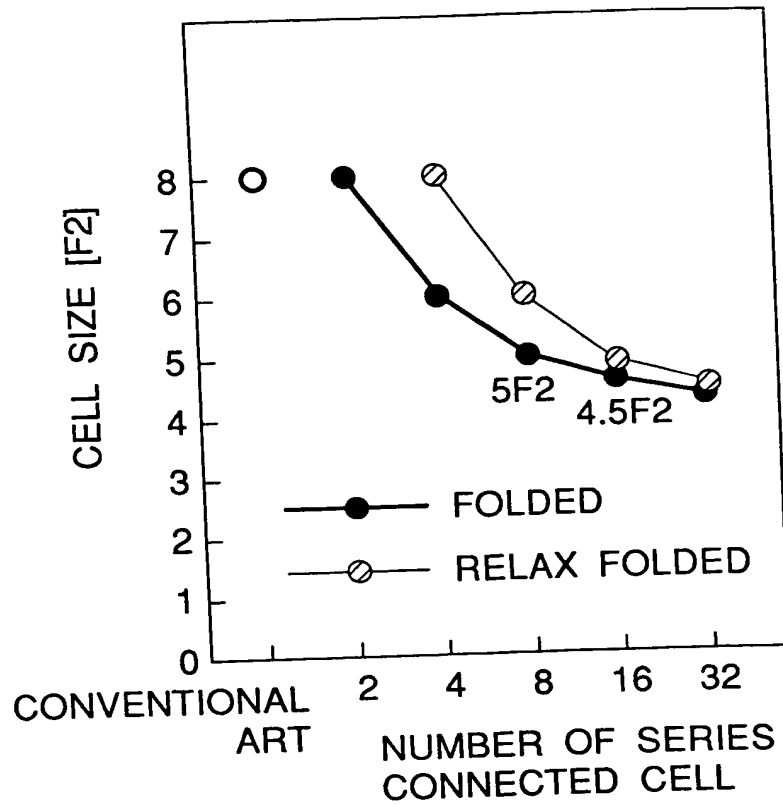


FIG. 81A

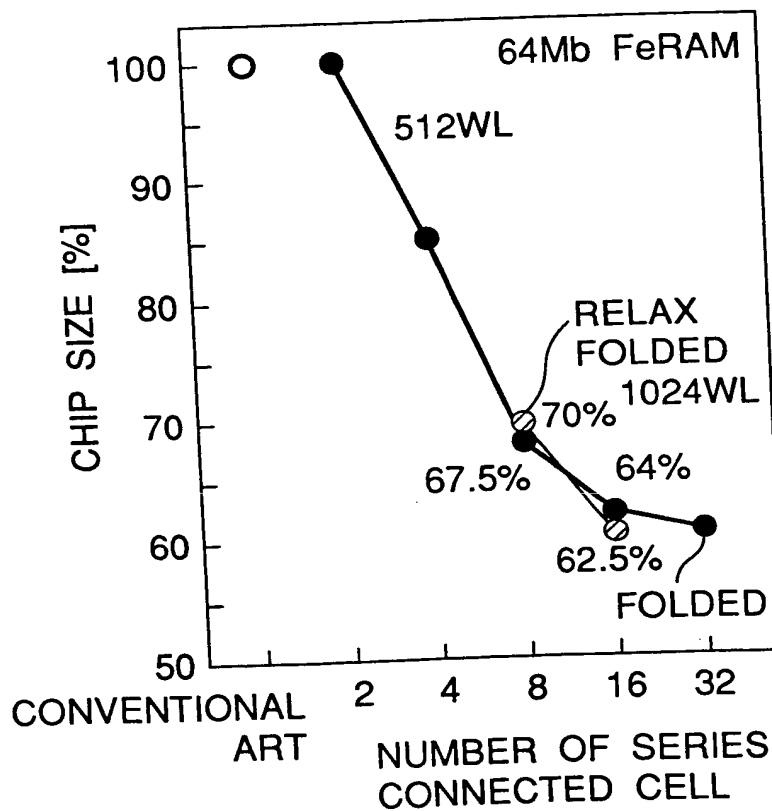


FIG. 81B

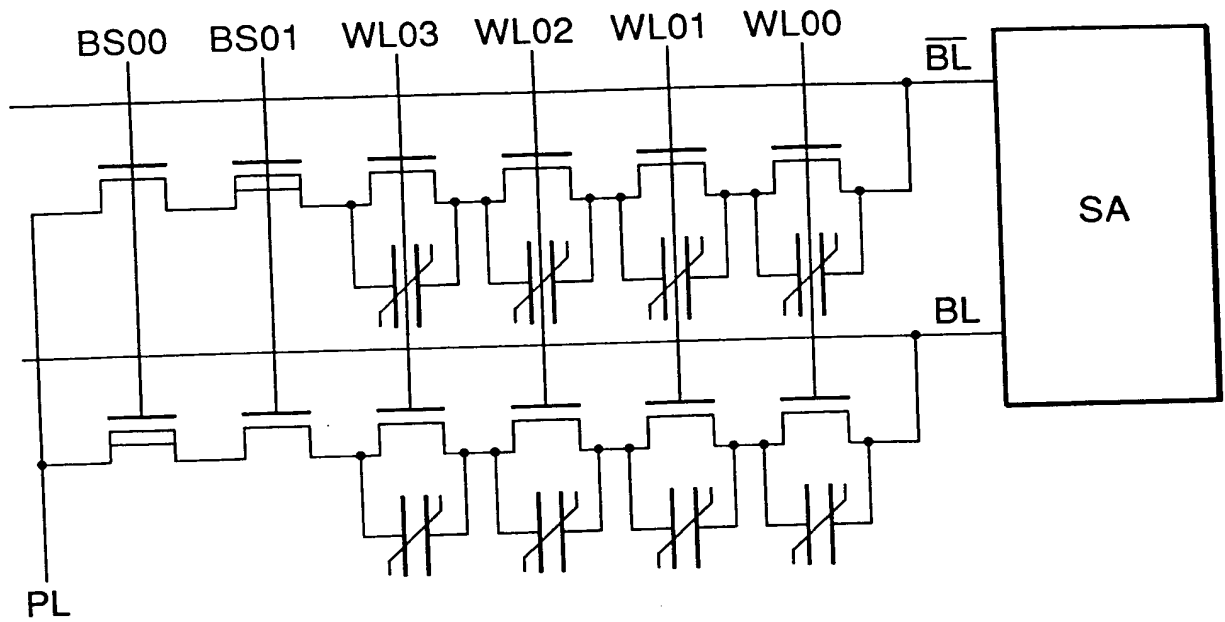


FIG. 82

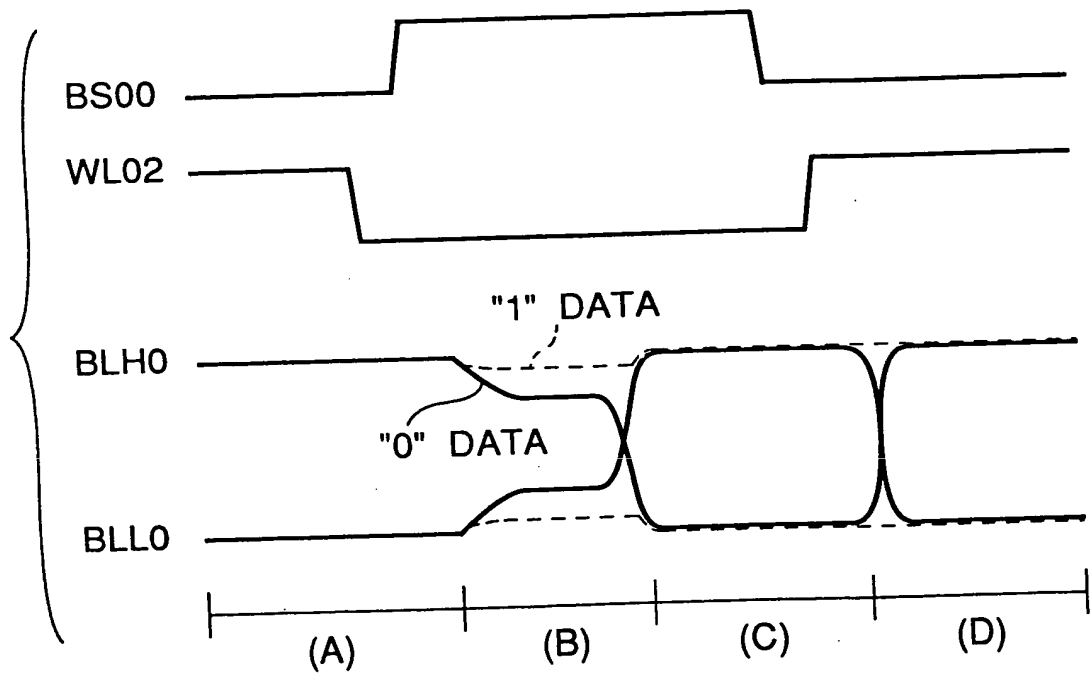


FIG. 84

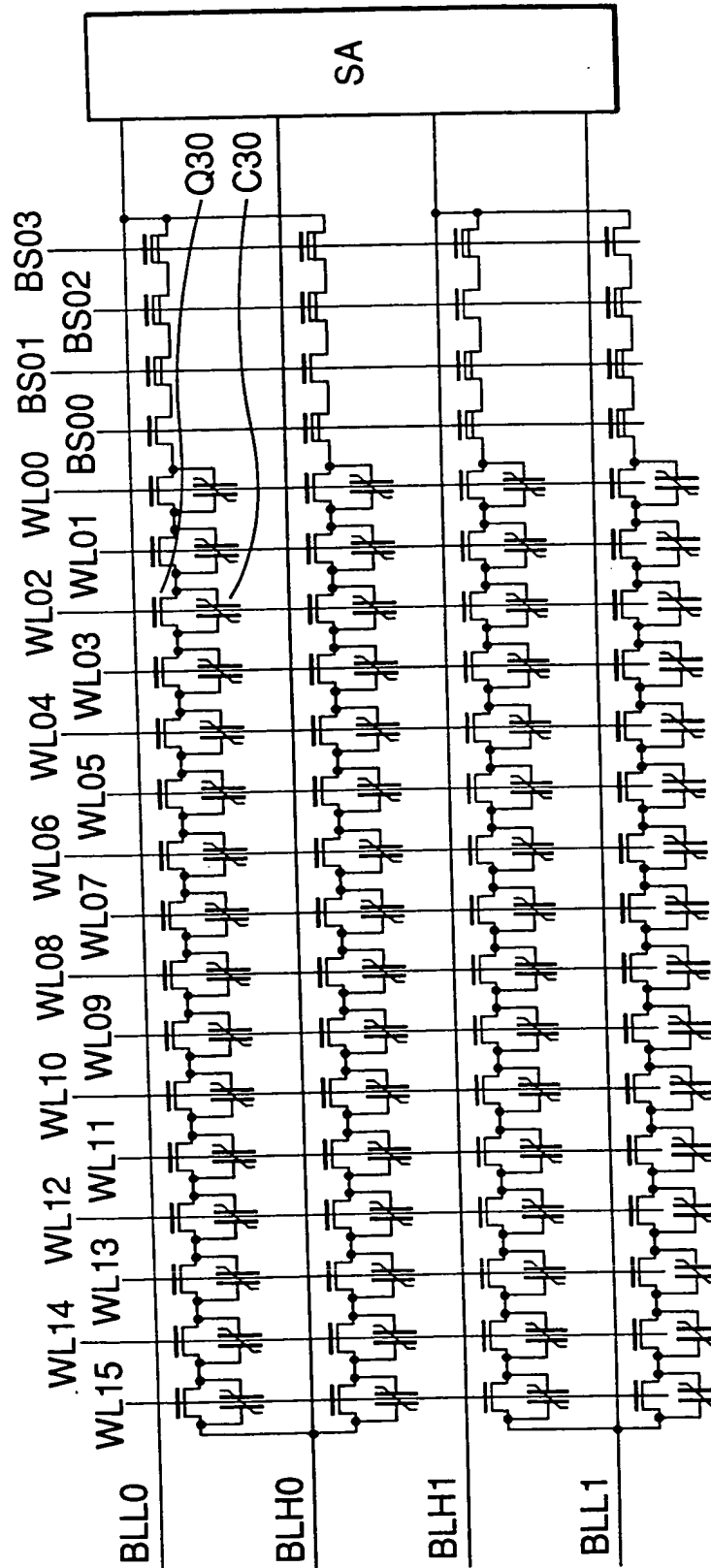


FIG. 83

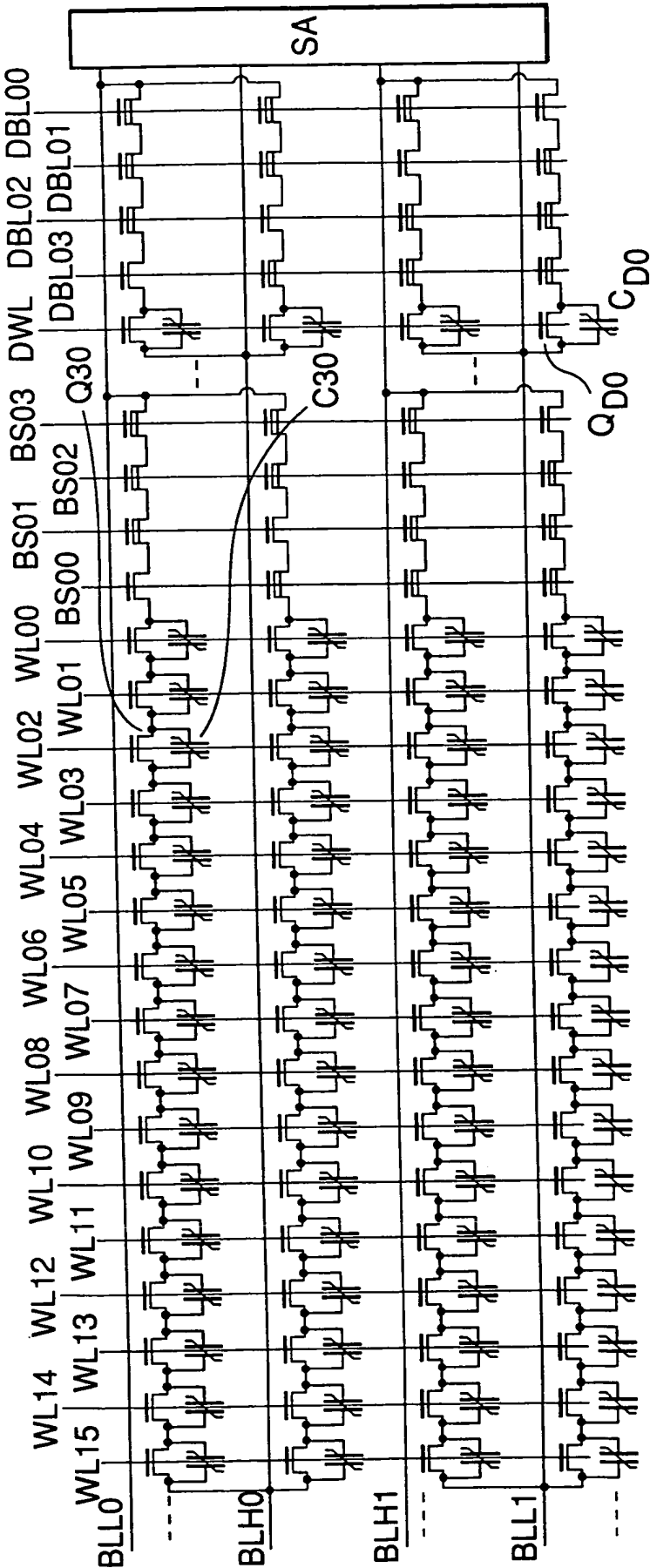


FIG. 85

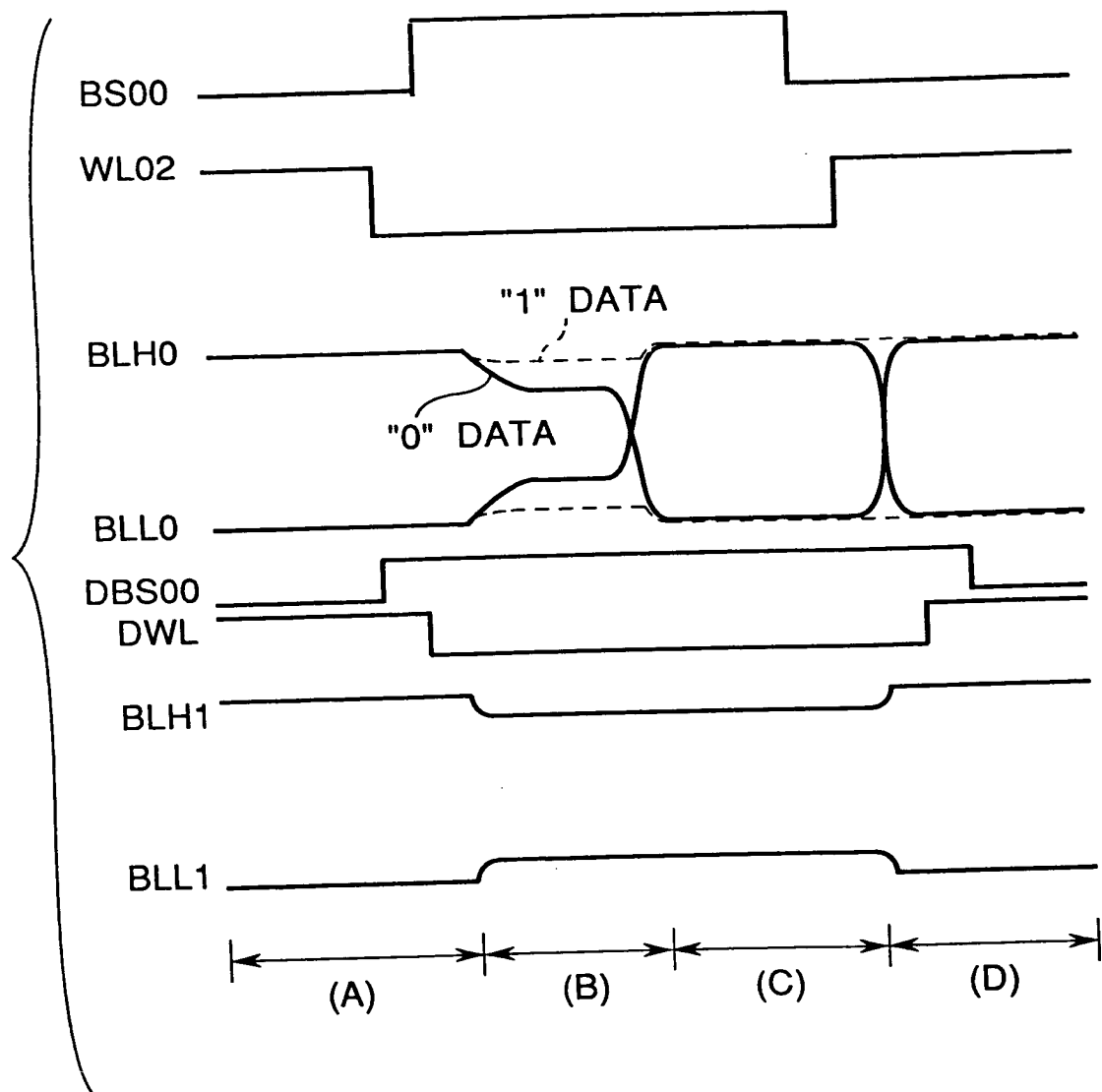


FIG. 86

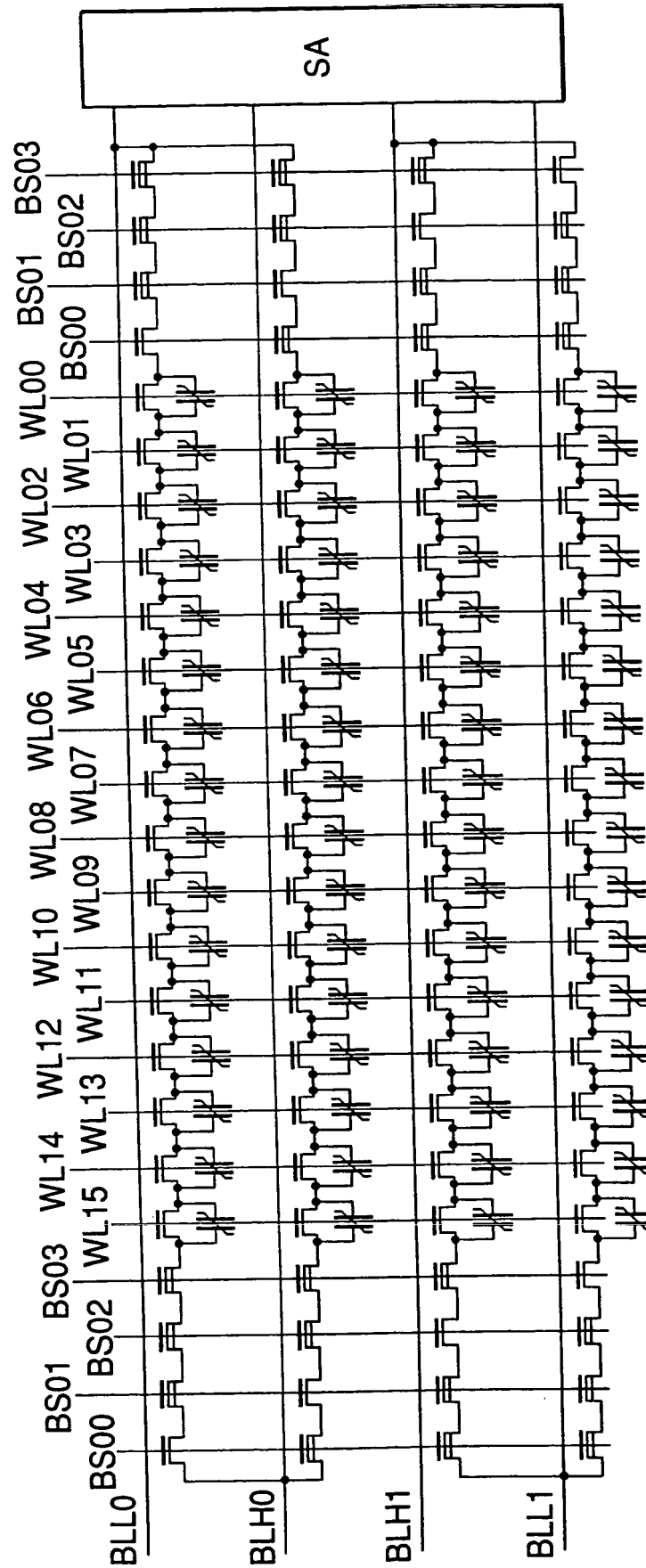


FIG. 87

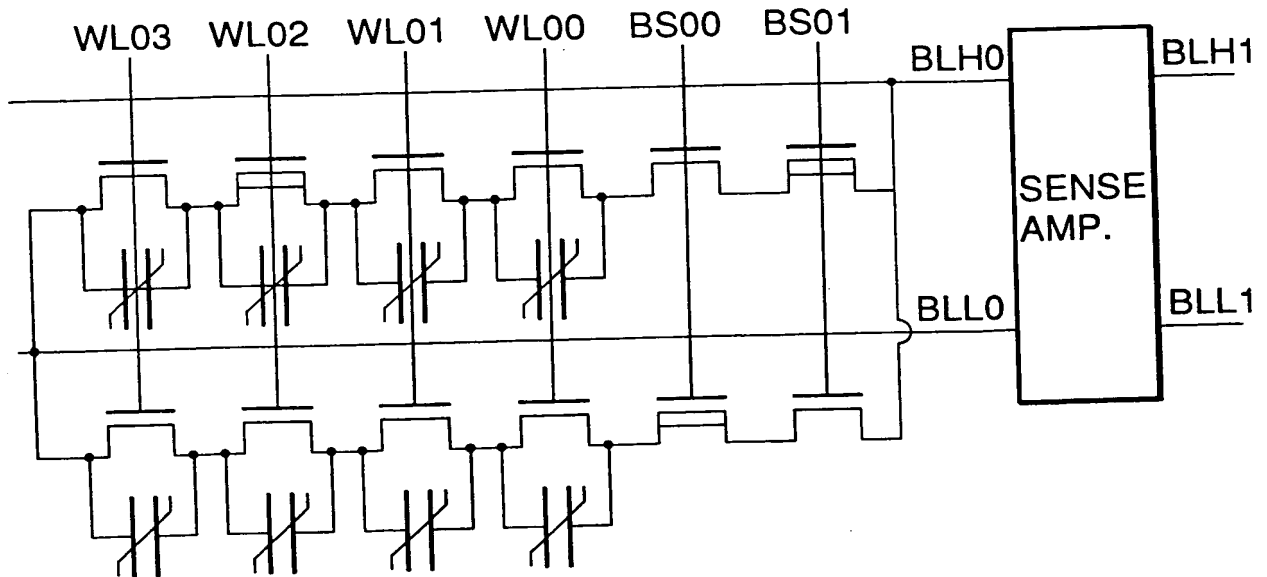


FIG. 88

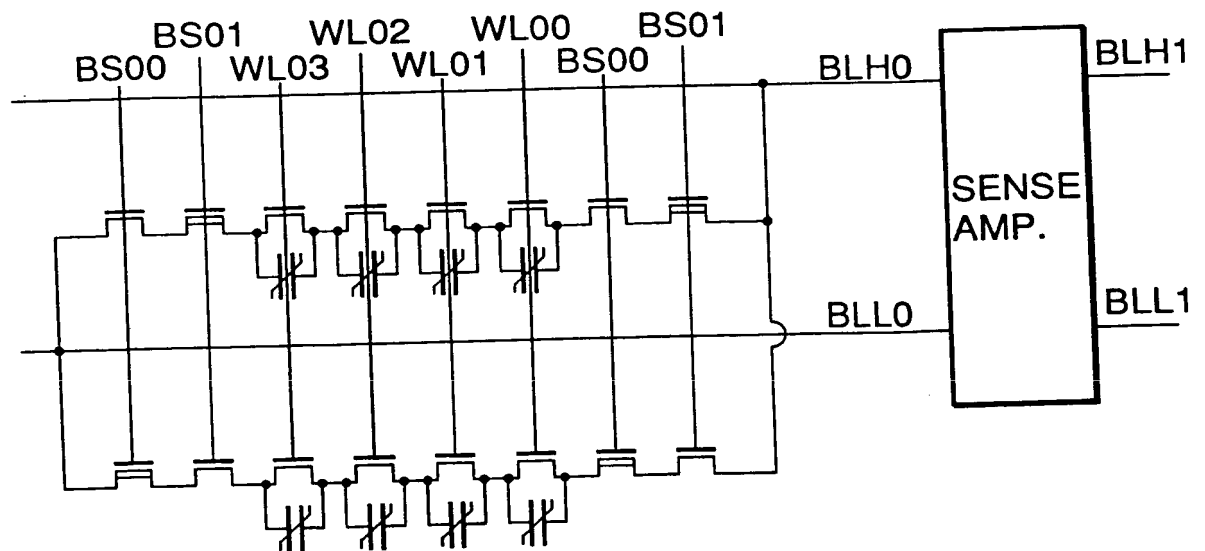


FIG. 89

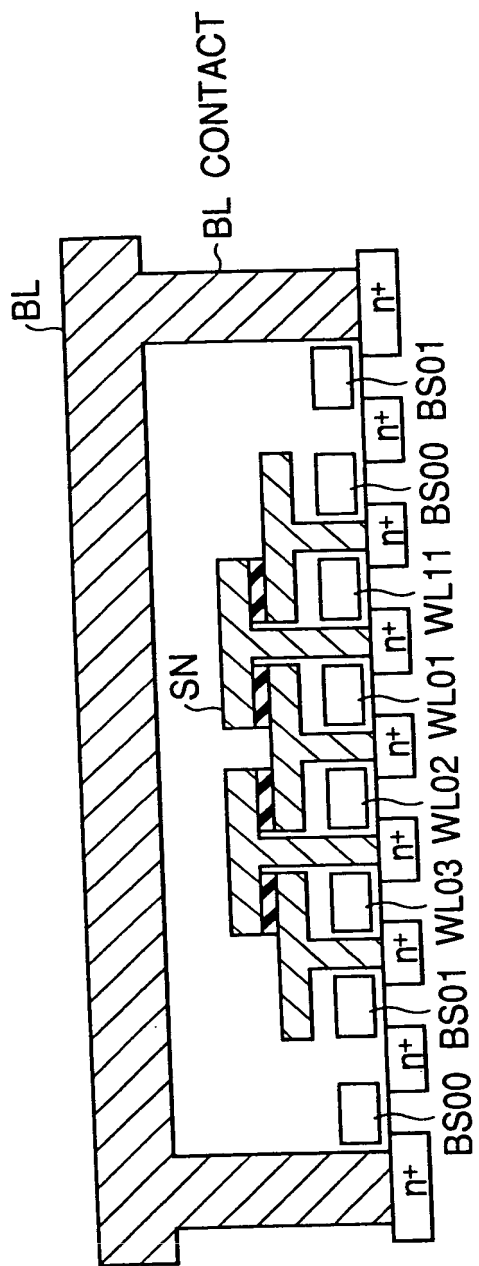


FIG. 90A

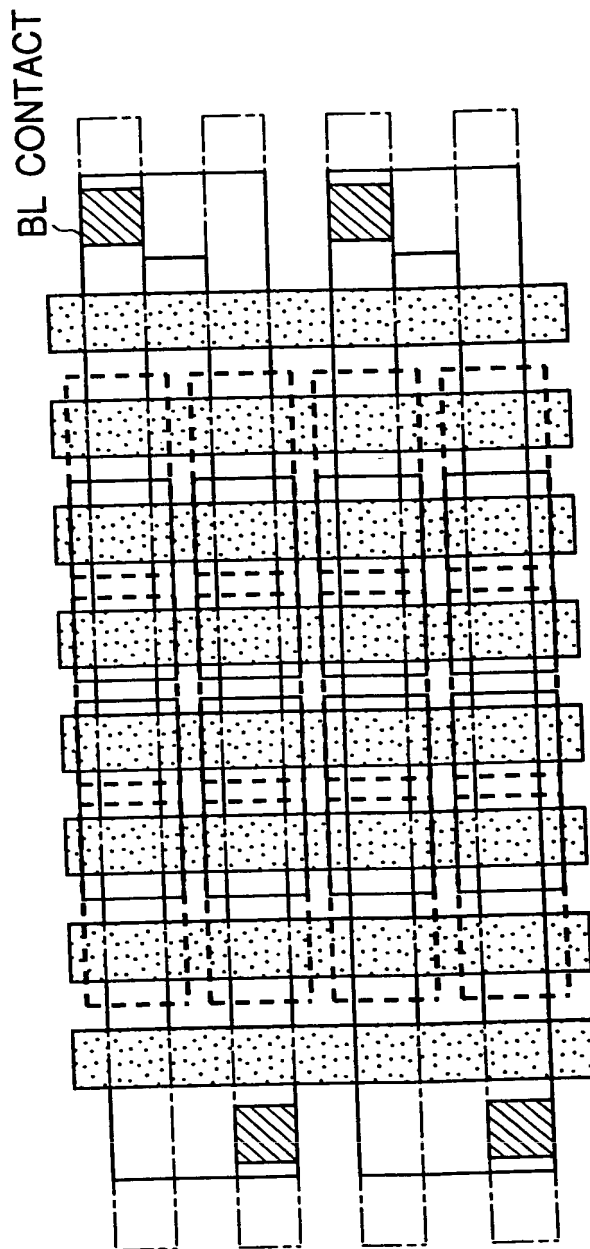


FIG. 90B

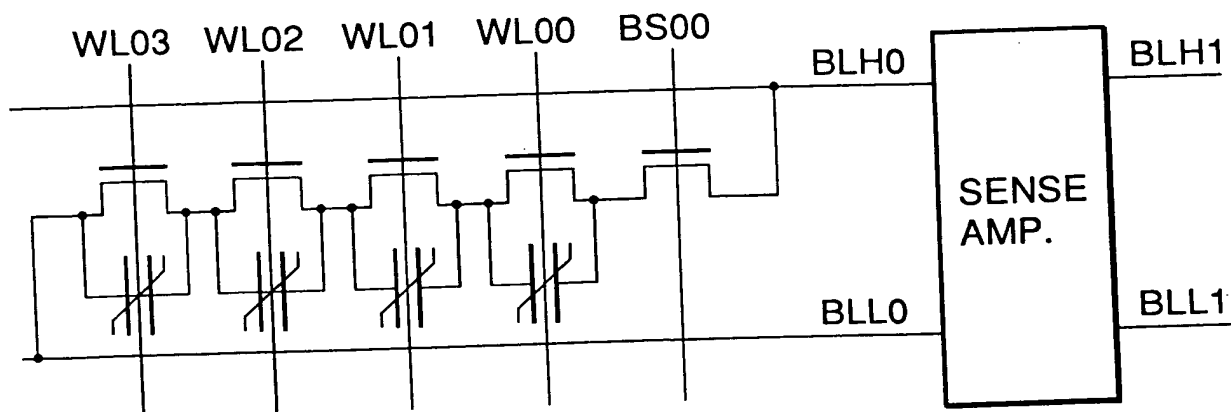


FIG. 91

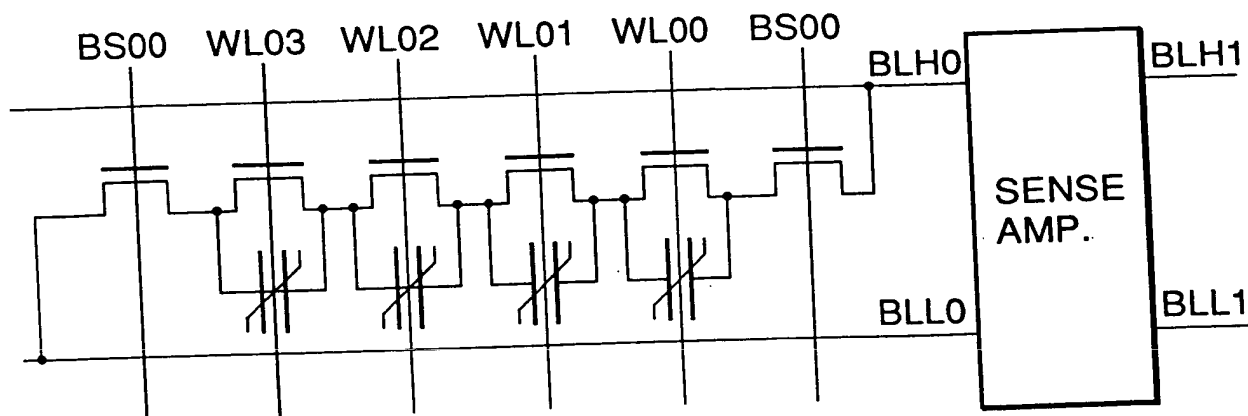


FIG. 92

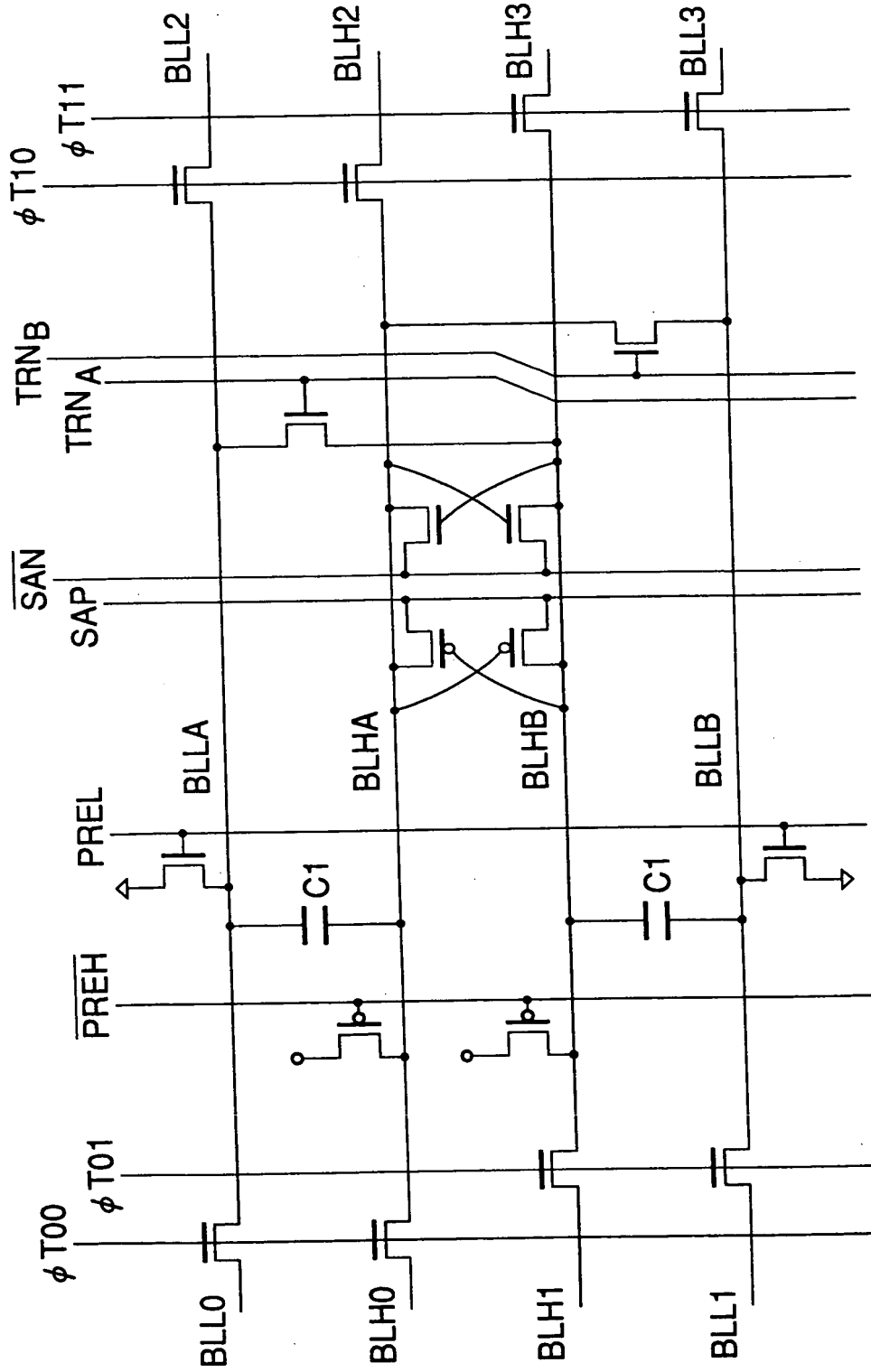
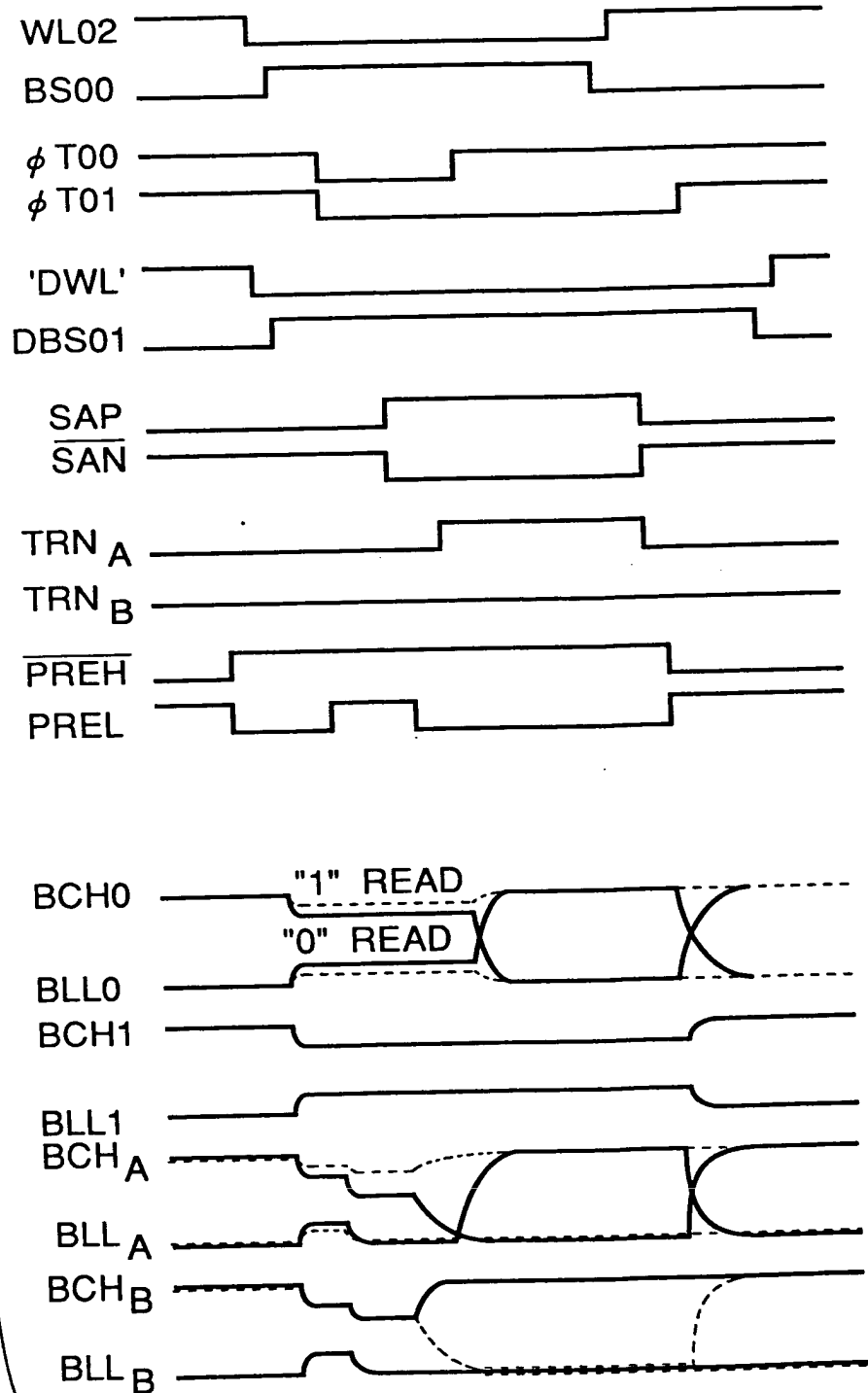


FIG. 93

FIG. 94



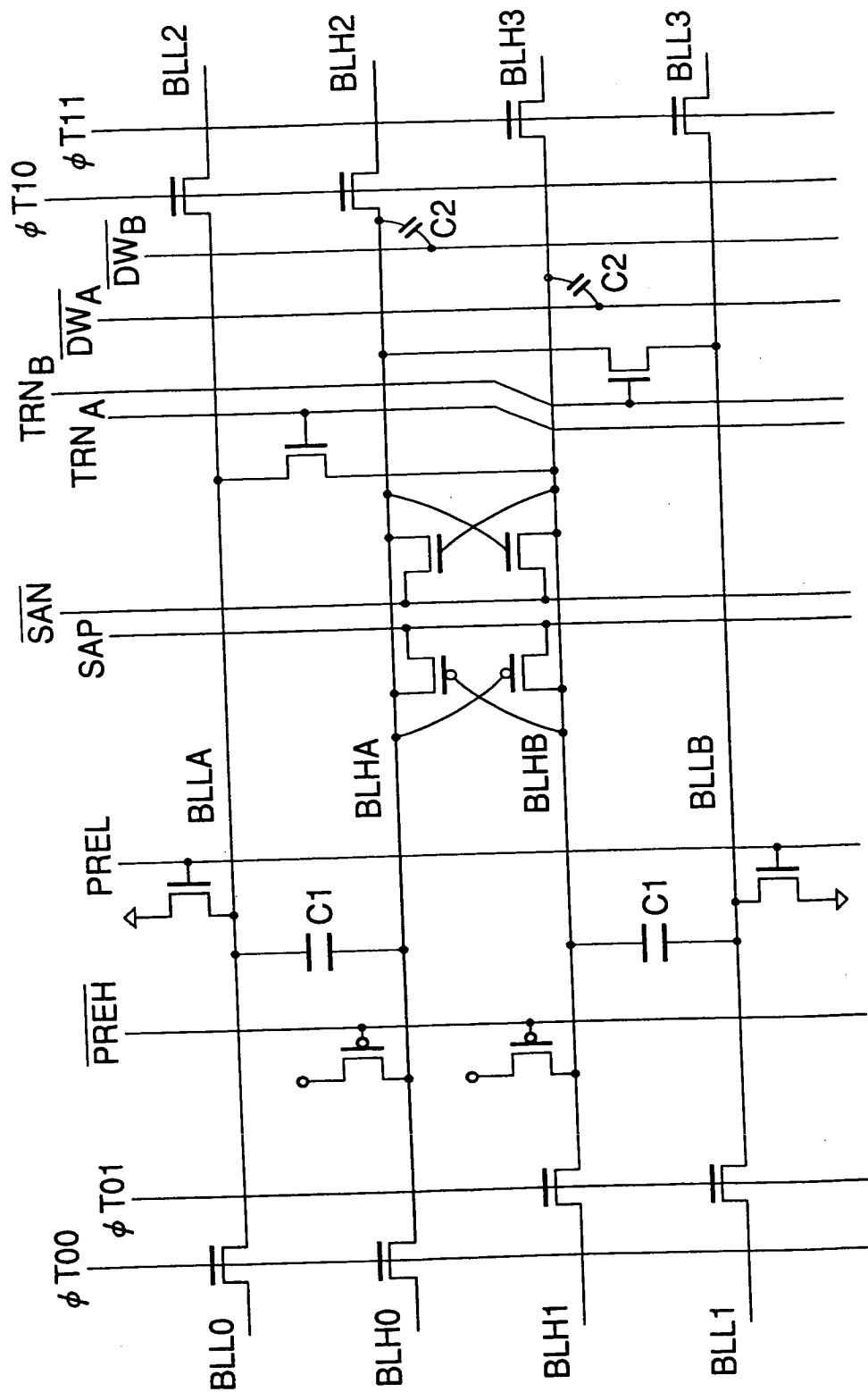
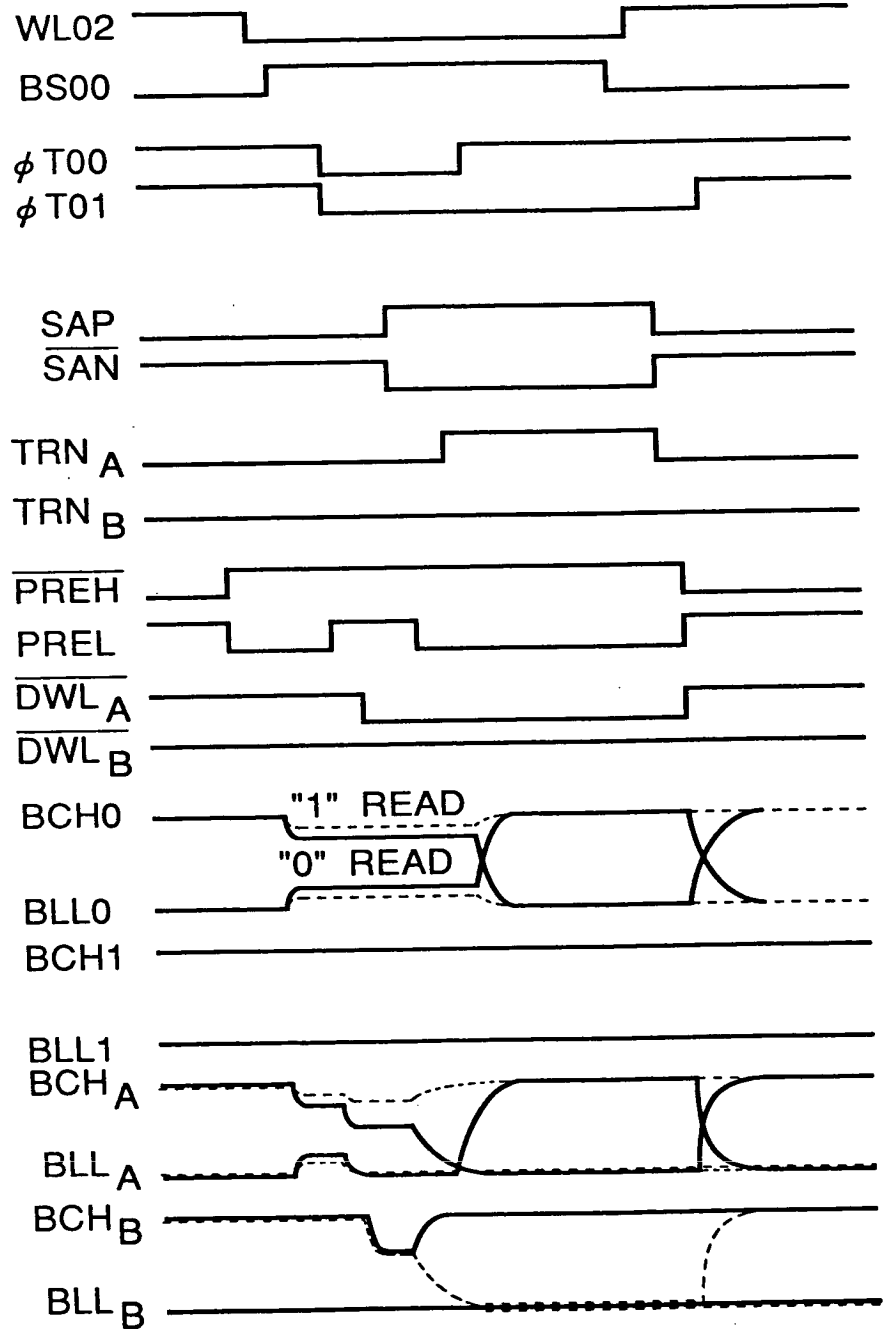


FIG. 95

FIG. 96



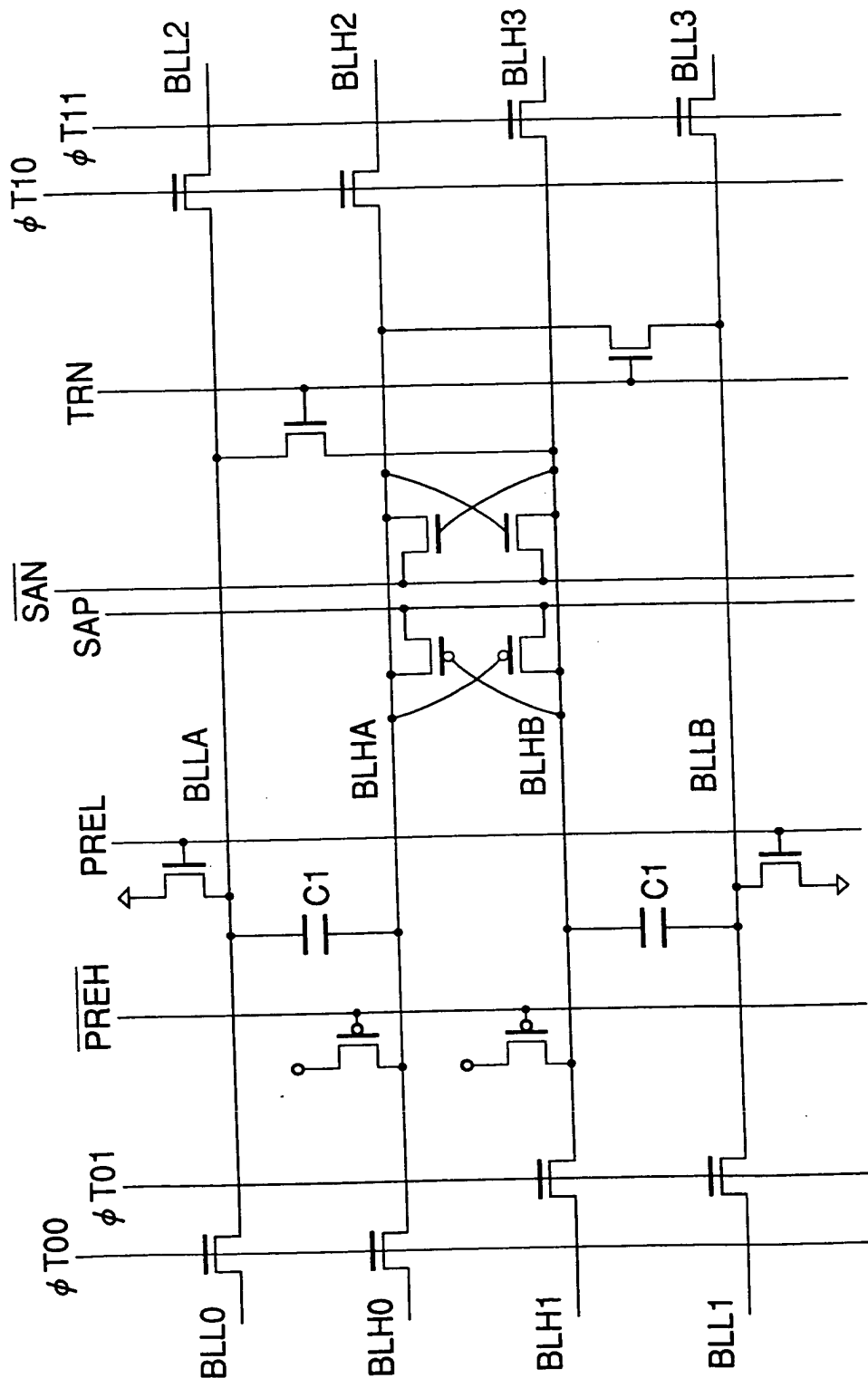
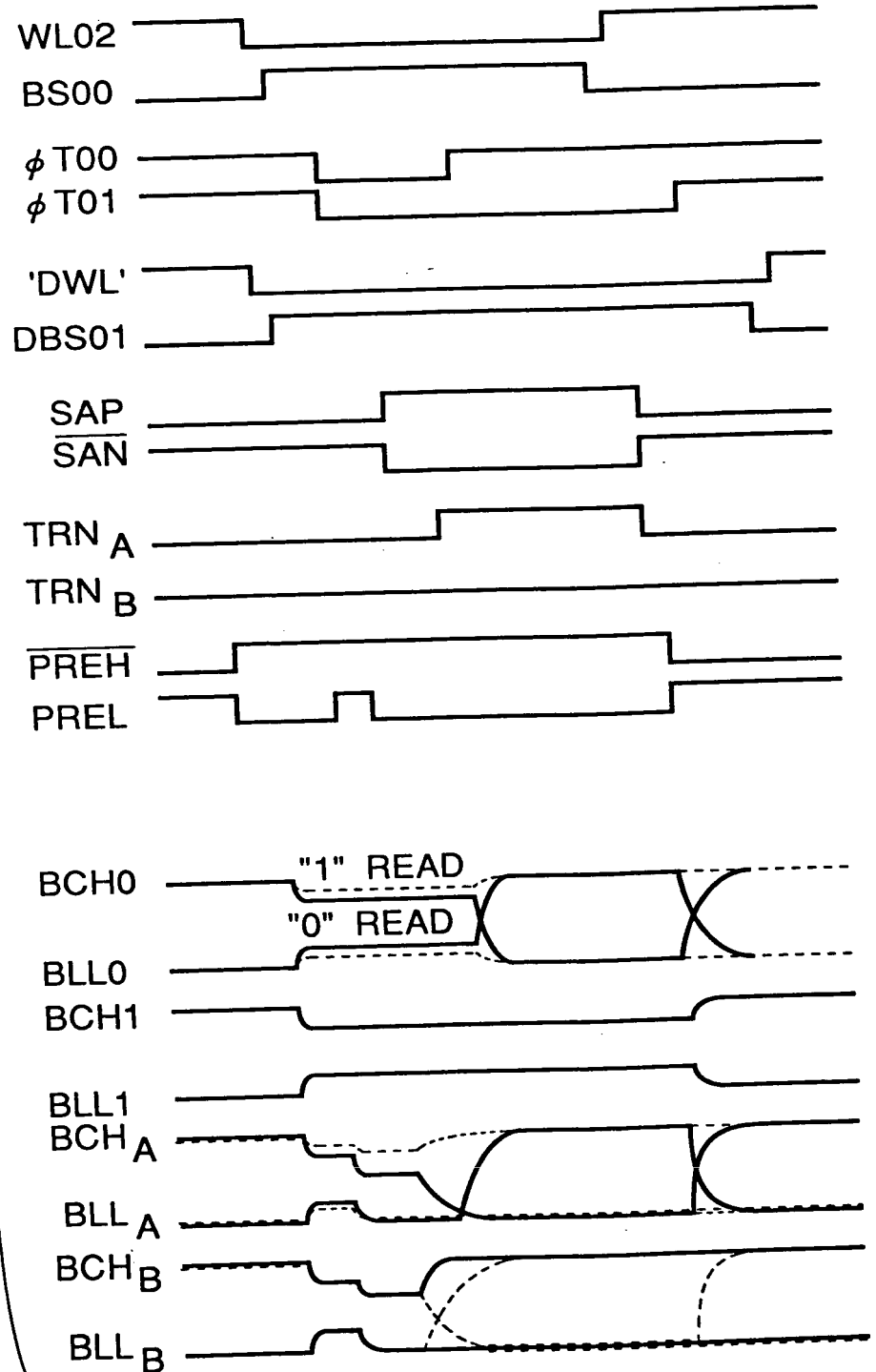


FIG. 97

FIG. 98



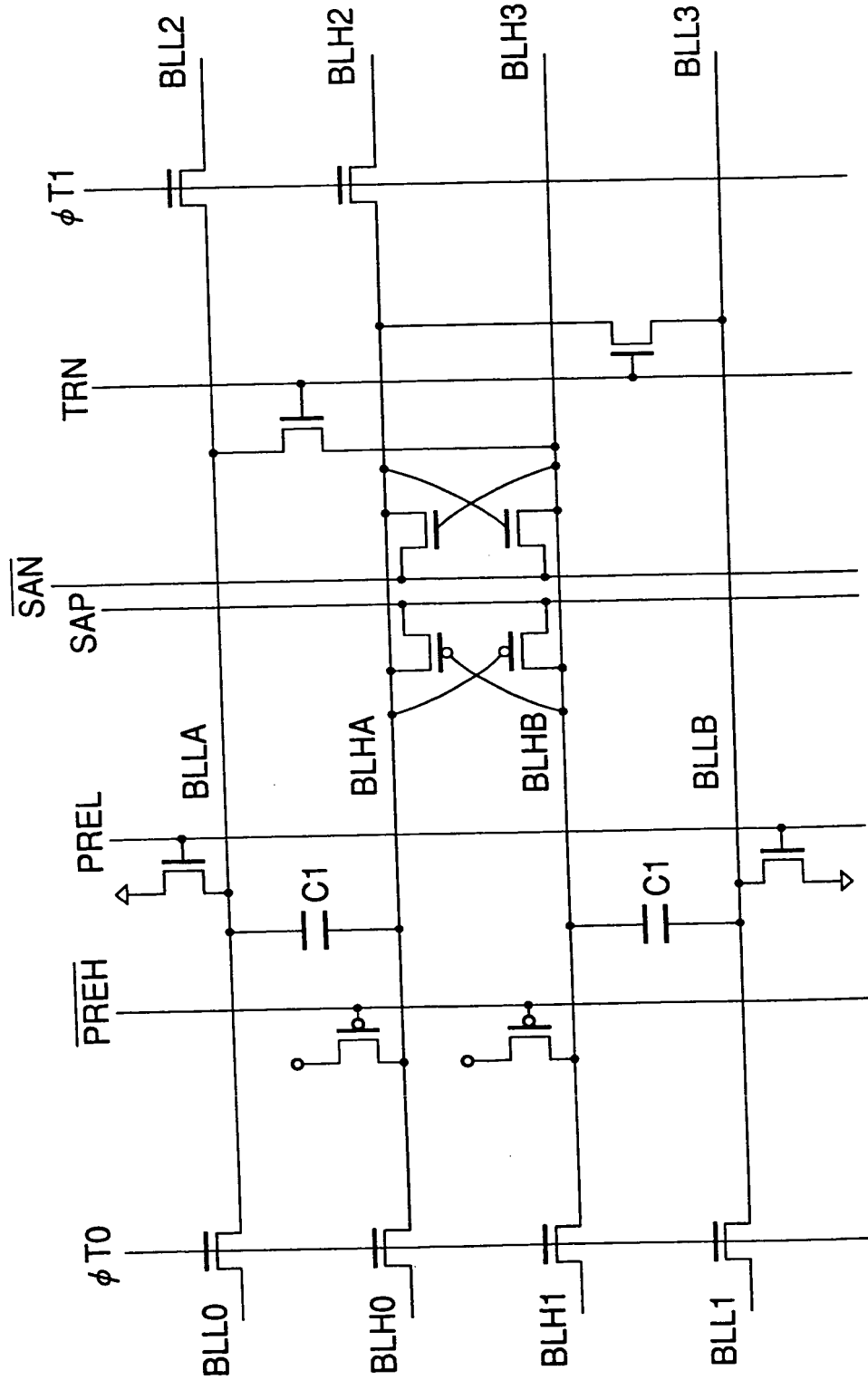
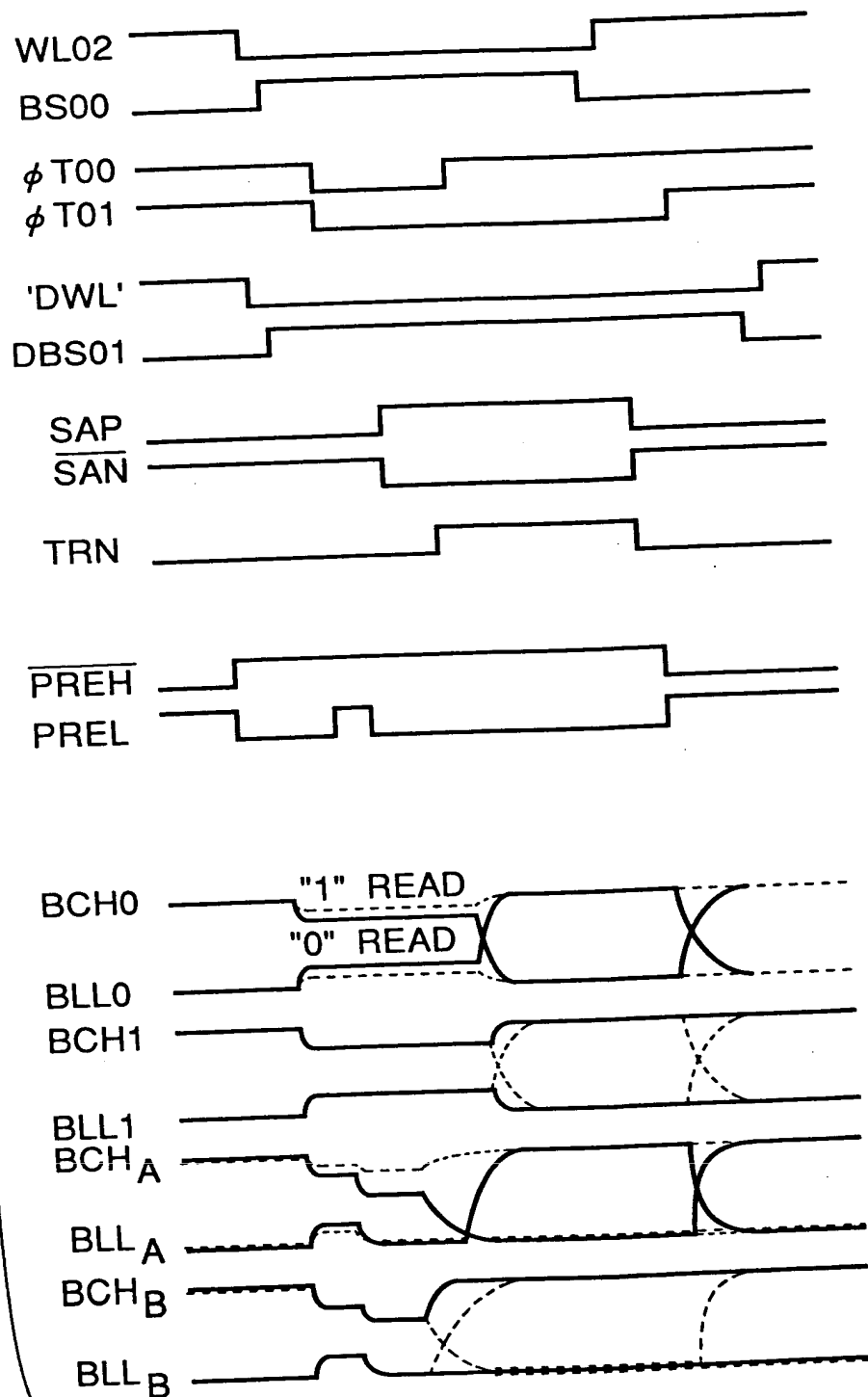


FIG. 99

FIG. 100



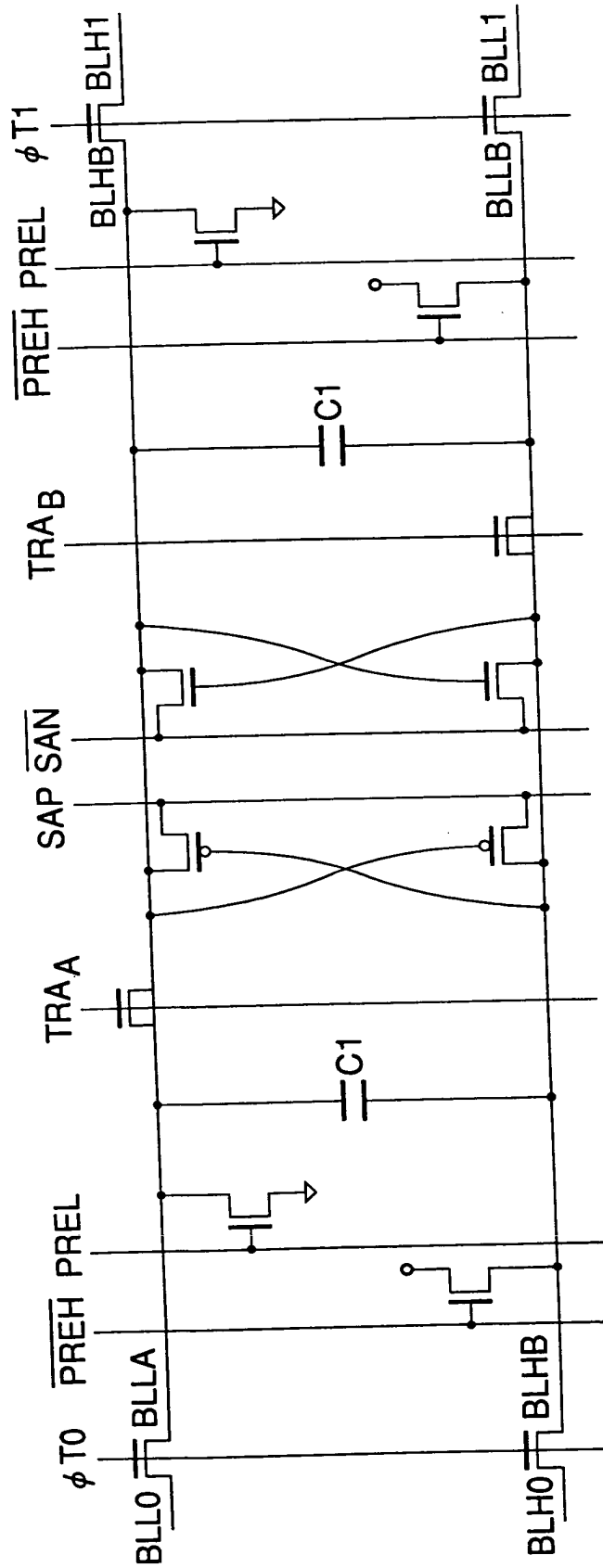


FIG. 101

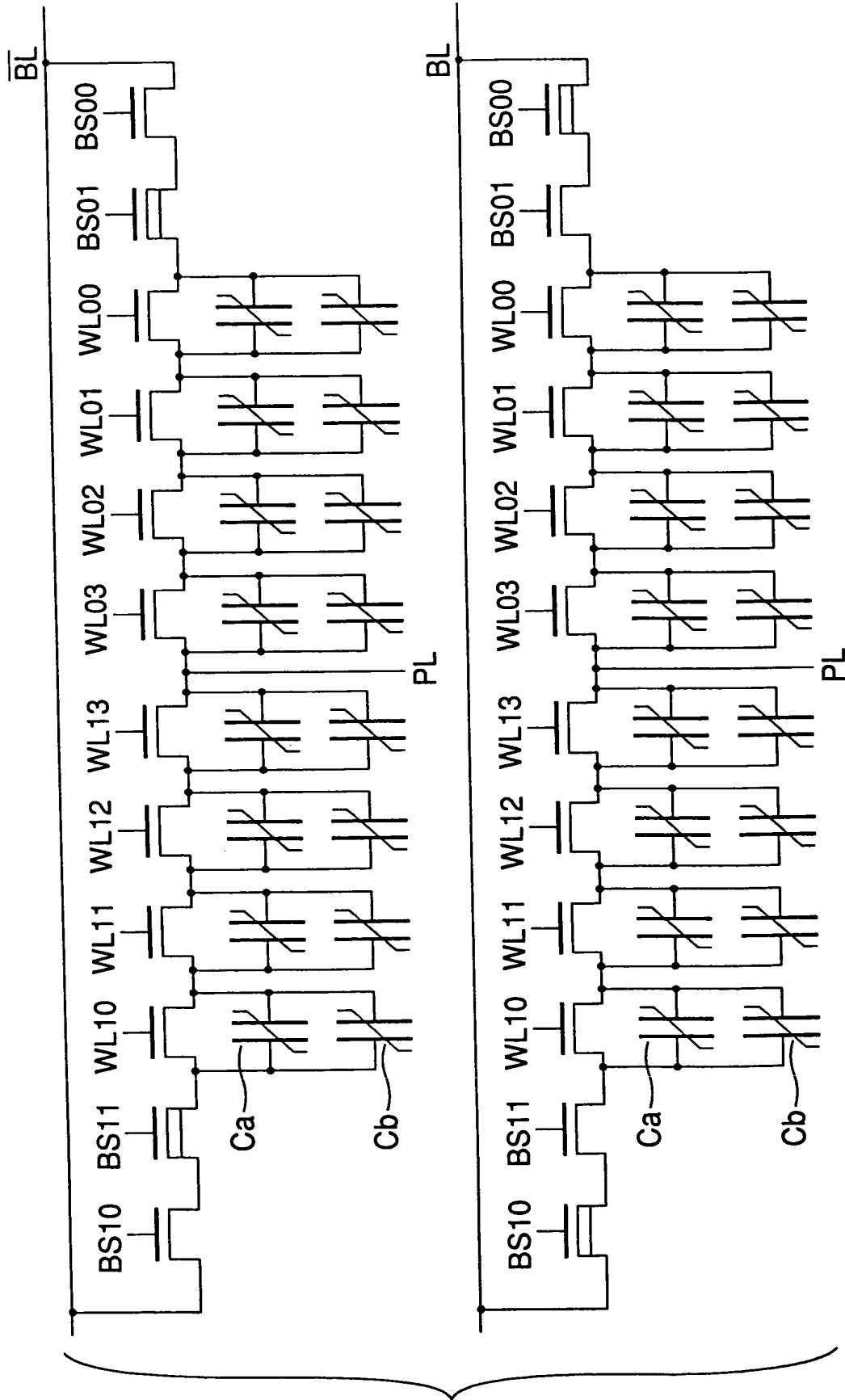


FIG. 102

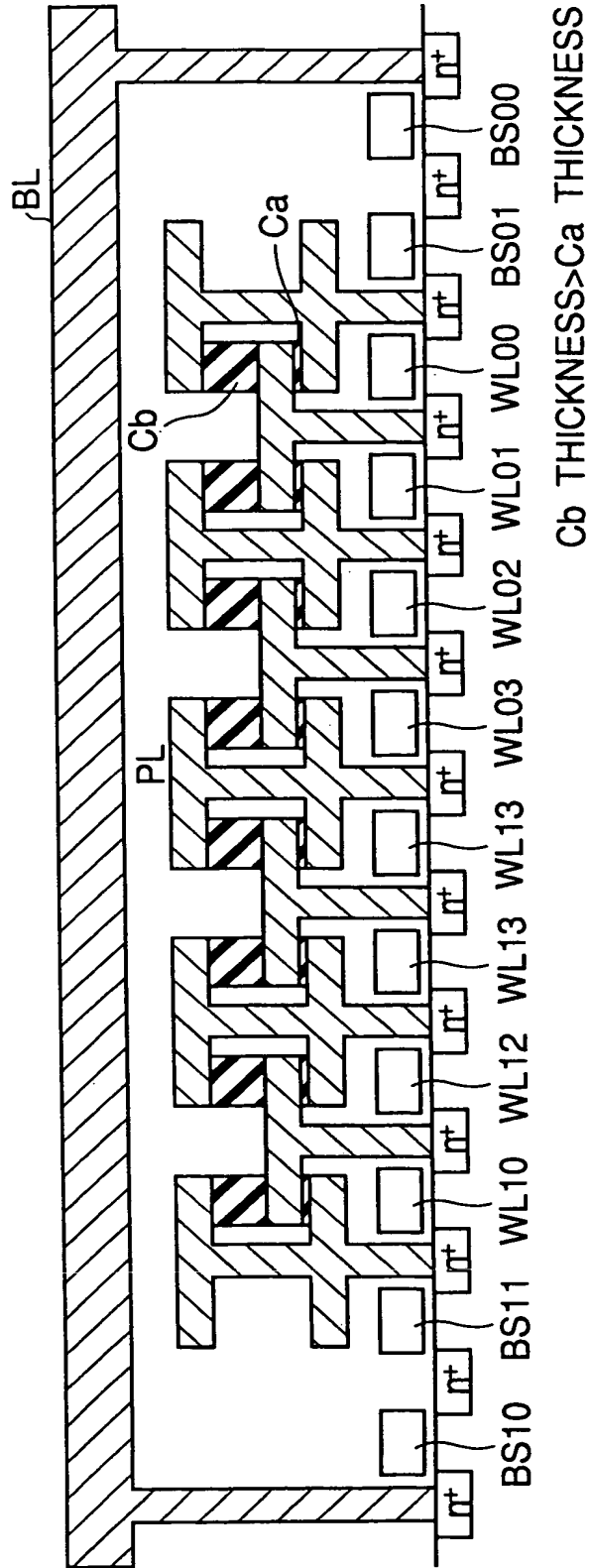


FIG. 103

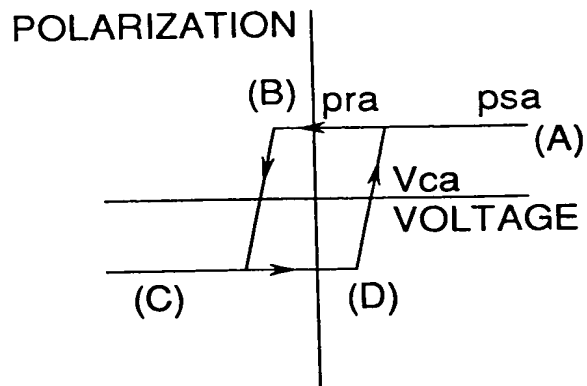


FIG. 104A

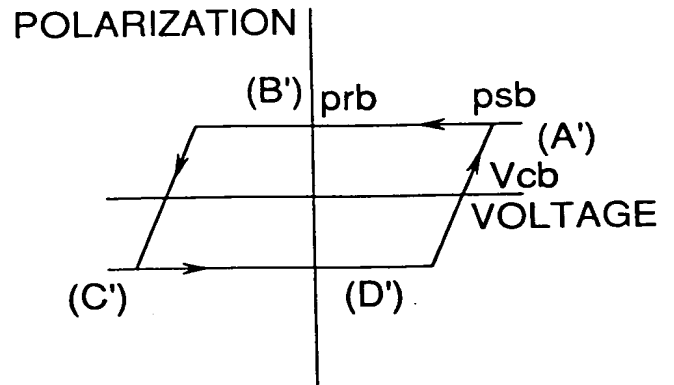


FIG. 104B

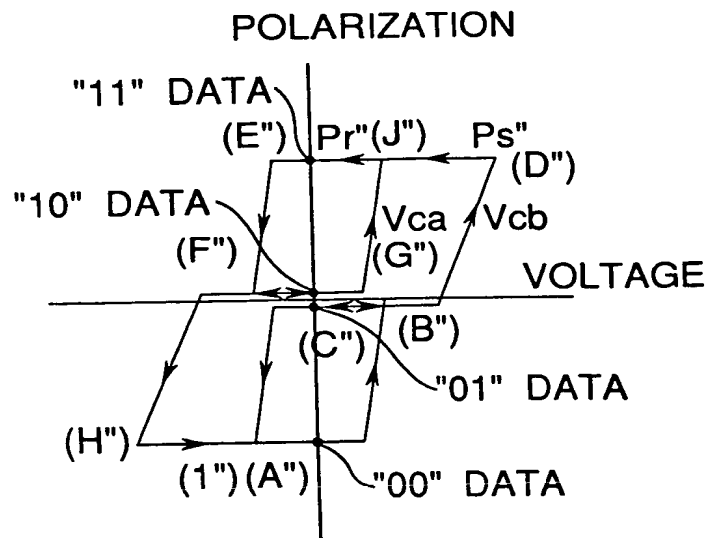


FIG. 104C

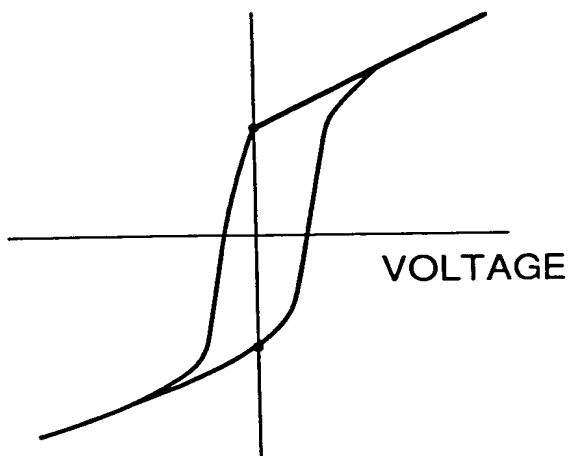


FIG. 105A

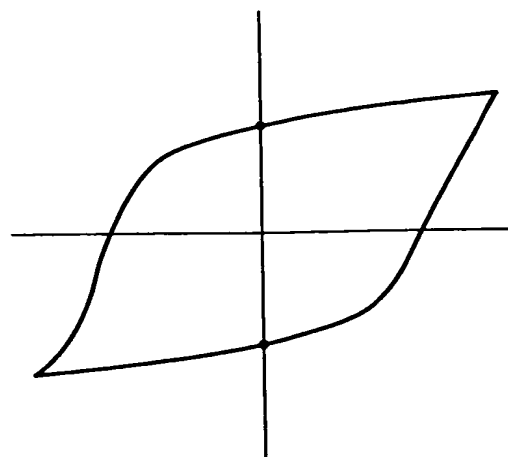


FIG. 105B

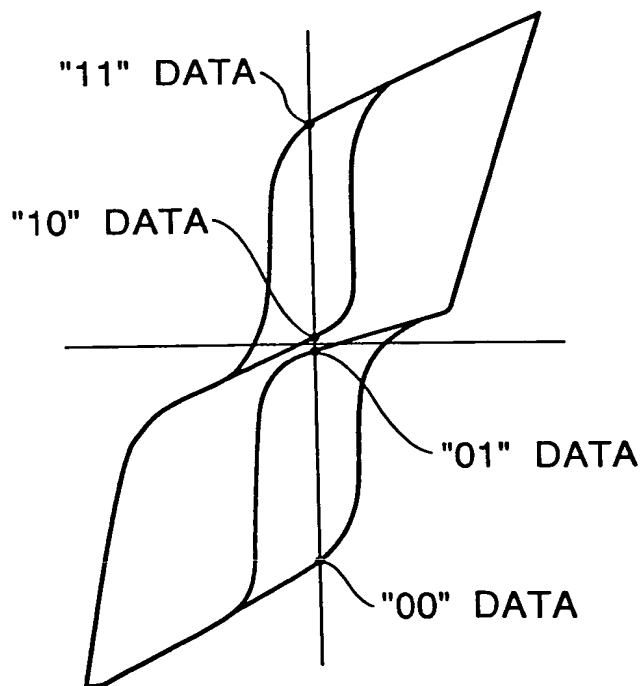


FIG. 105C

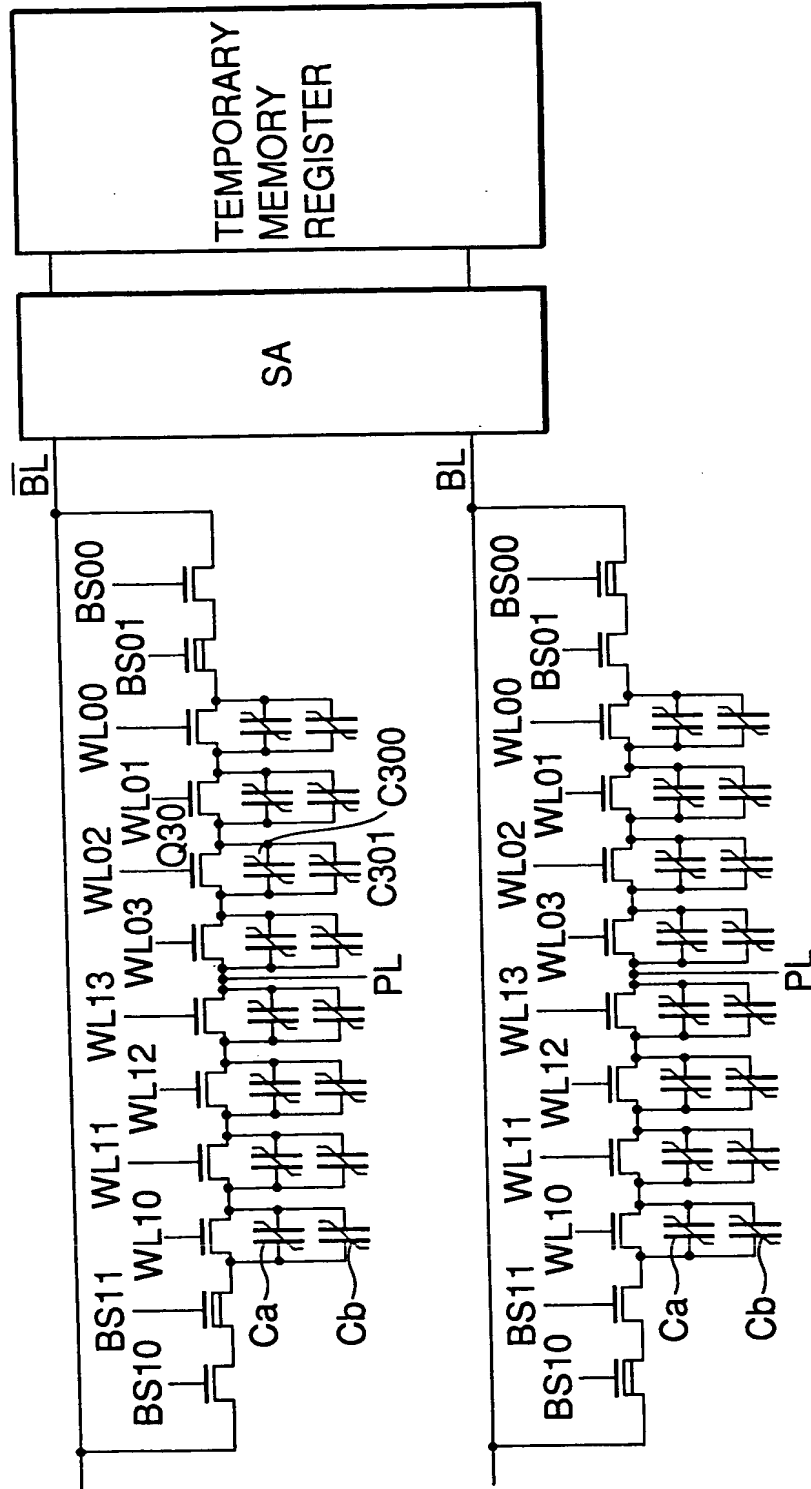


FIG. 106

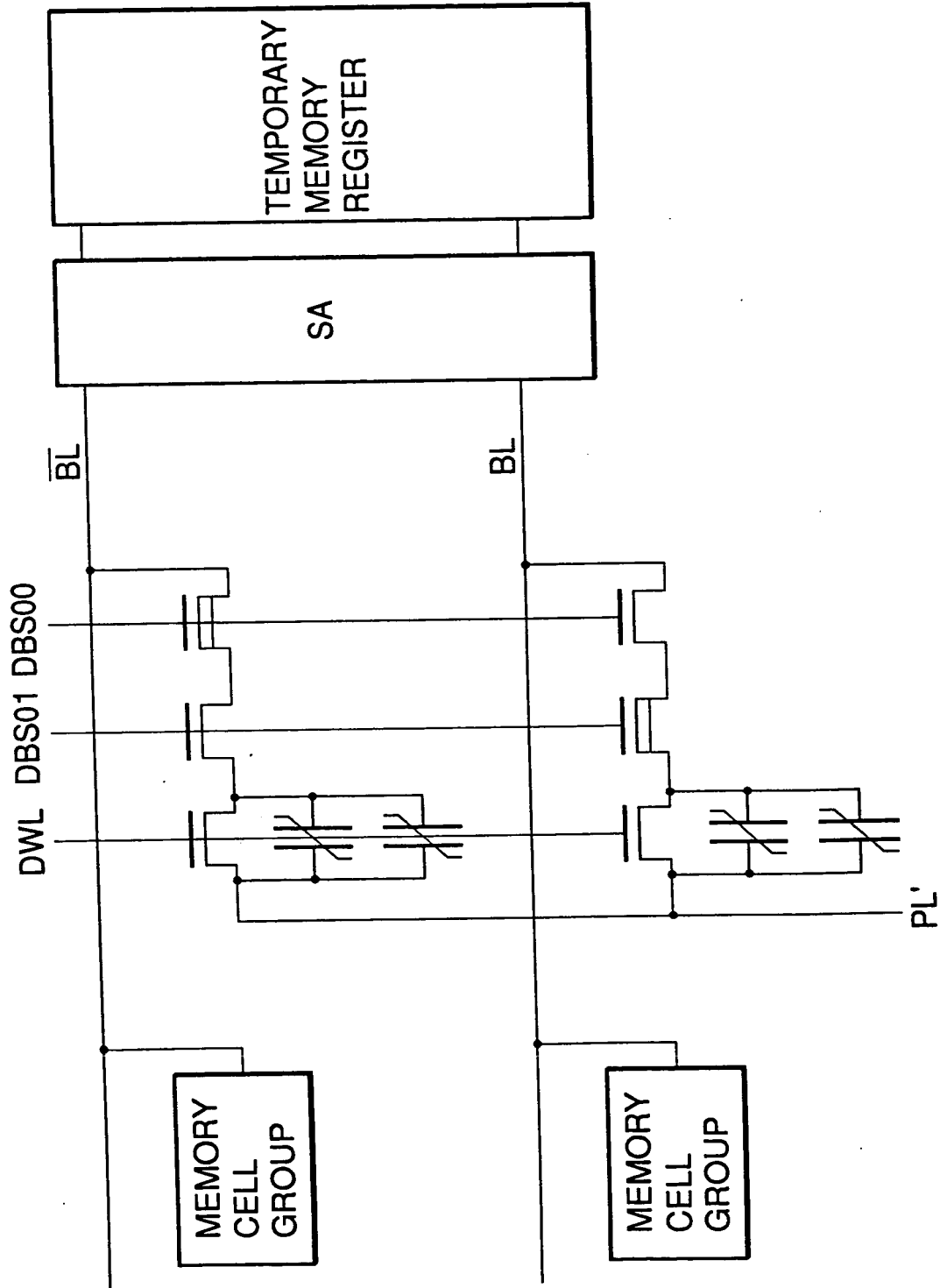


FIG.107

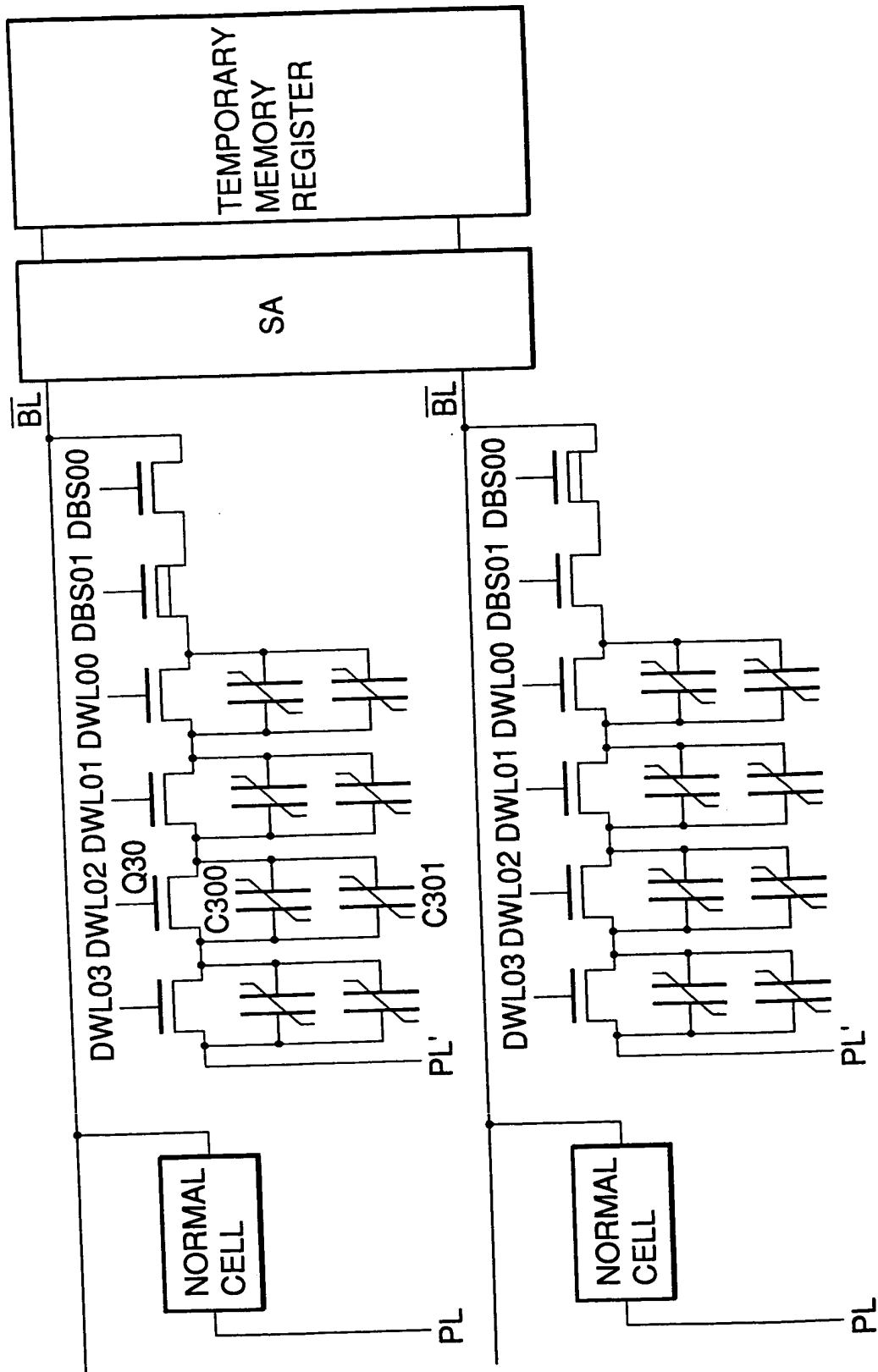


FIG. 108

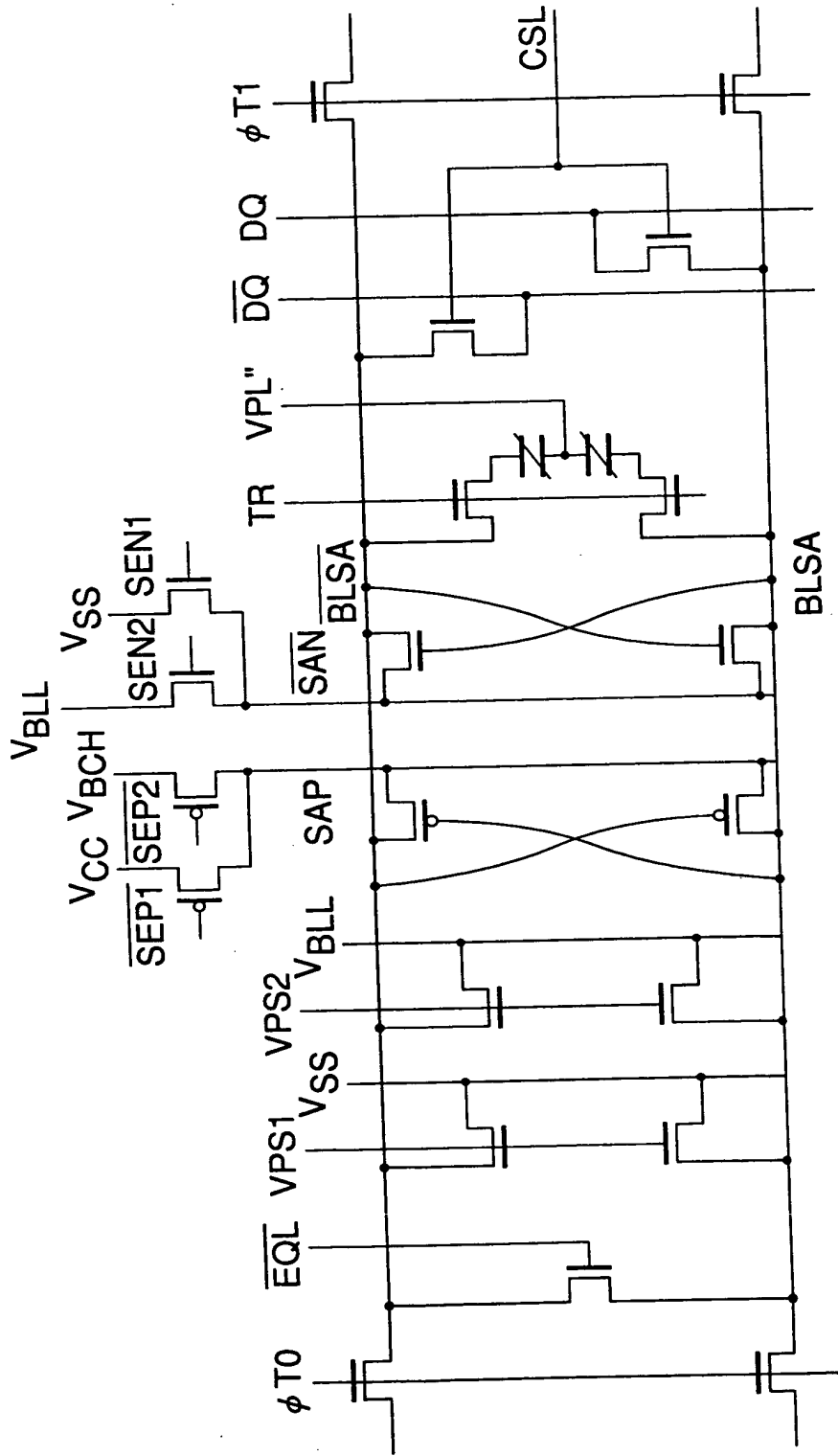


FIG. 109

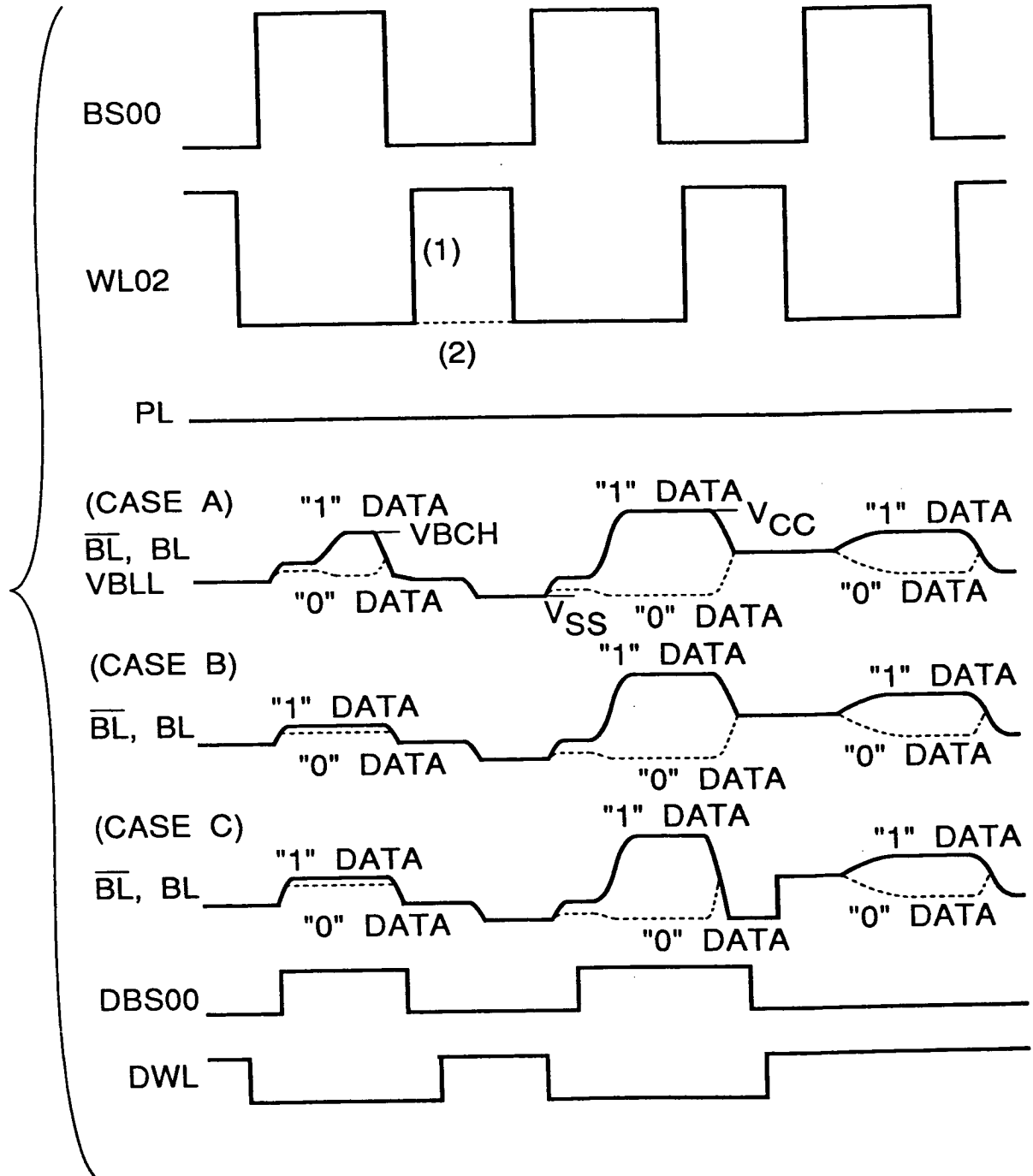


FIG.110

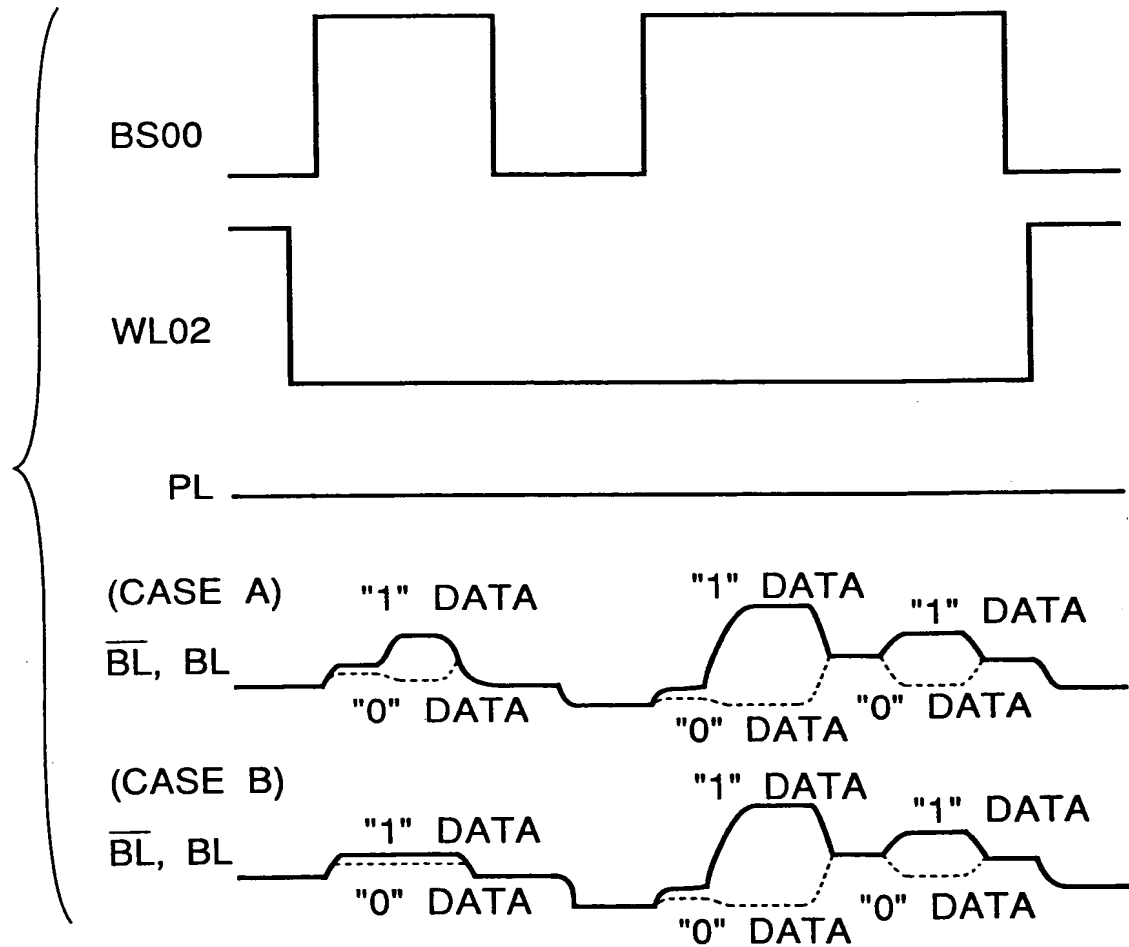
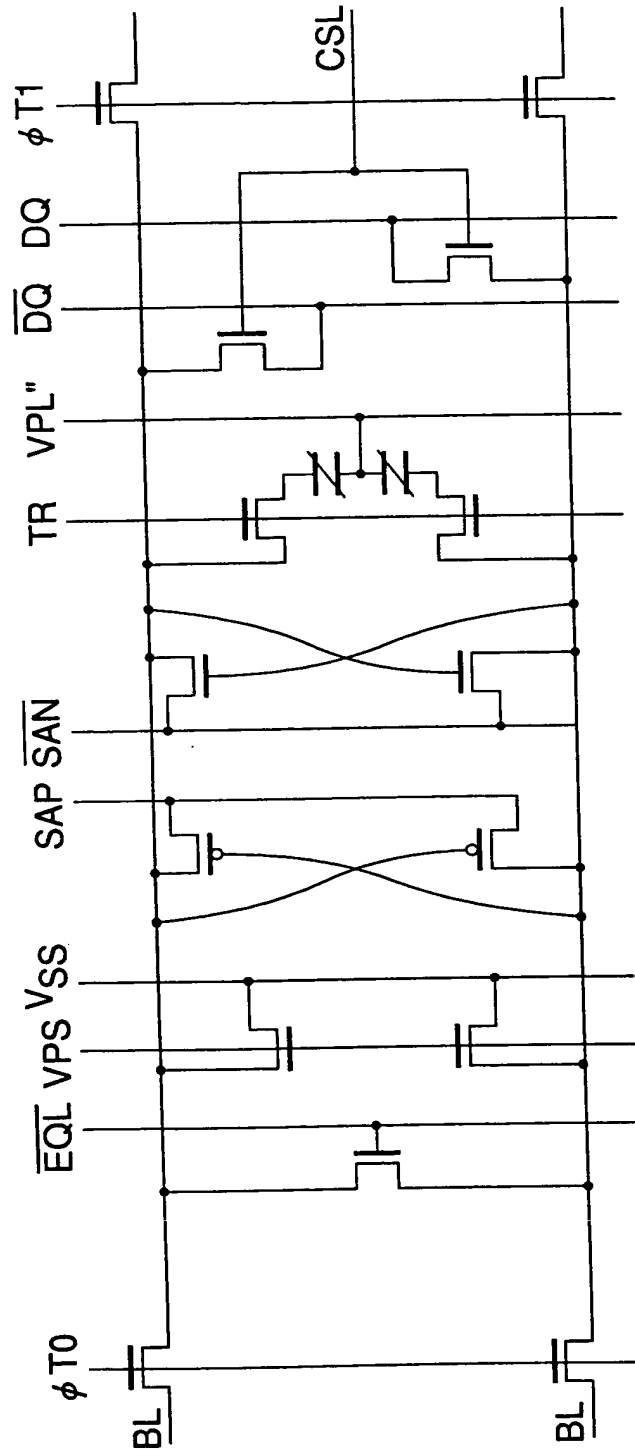


FIG. 111



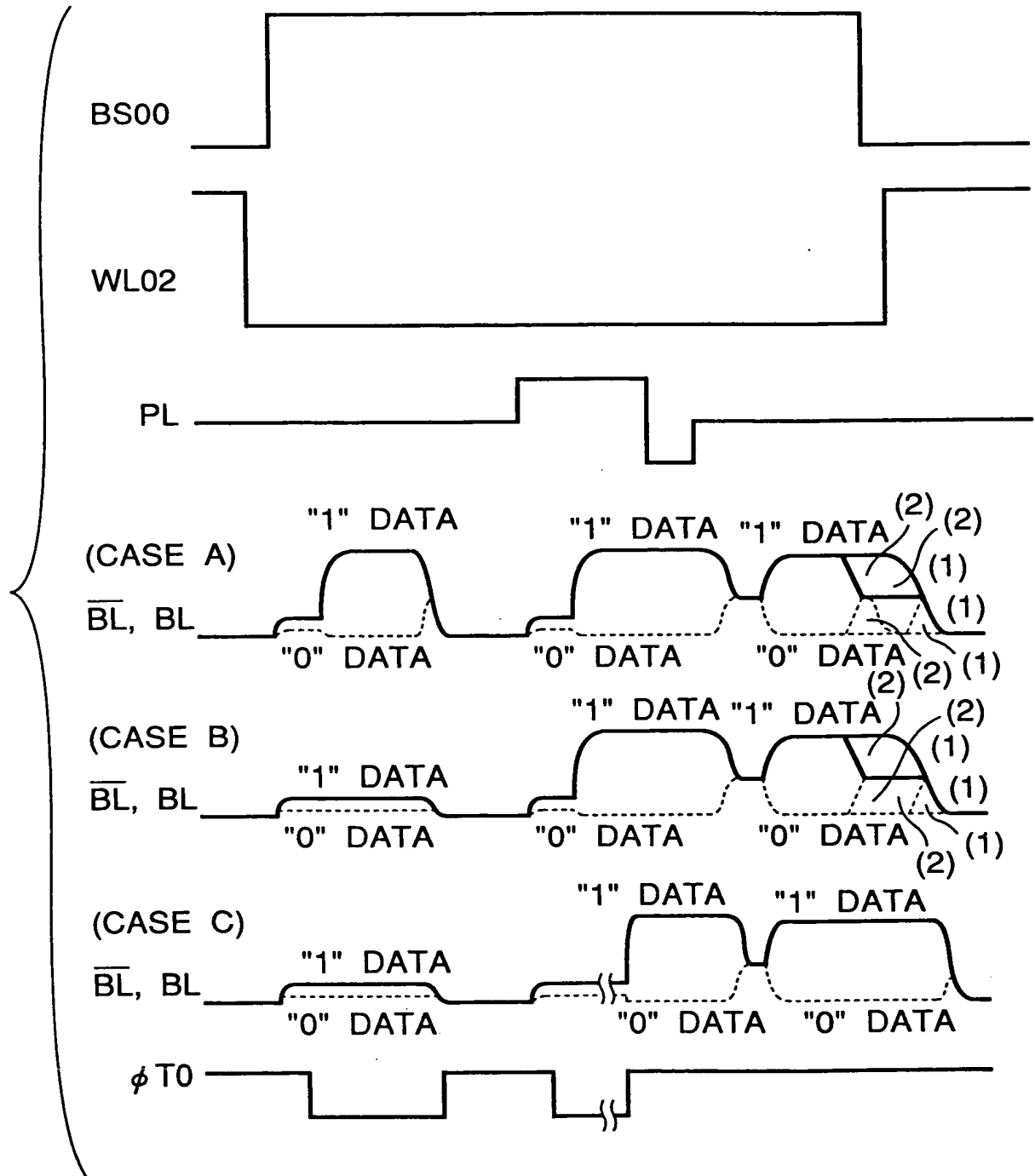


FIG. 113

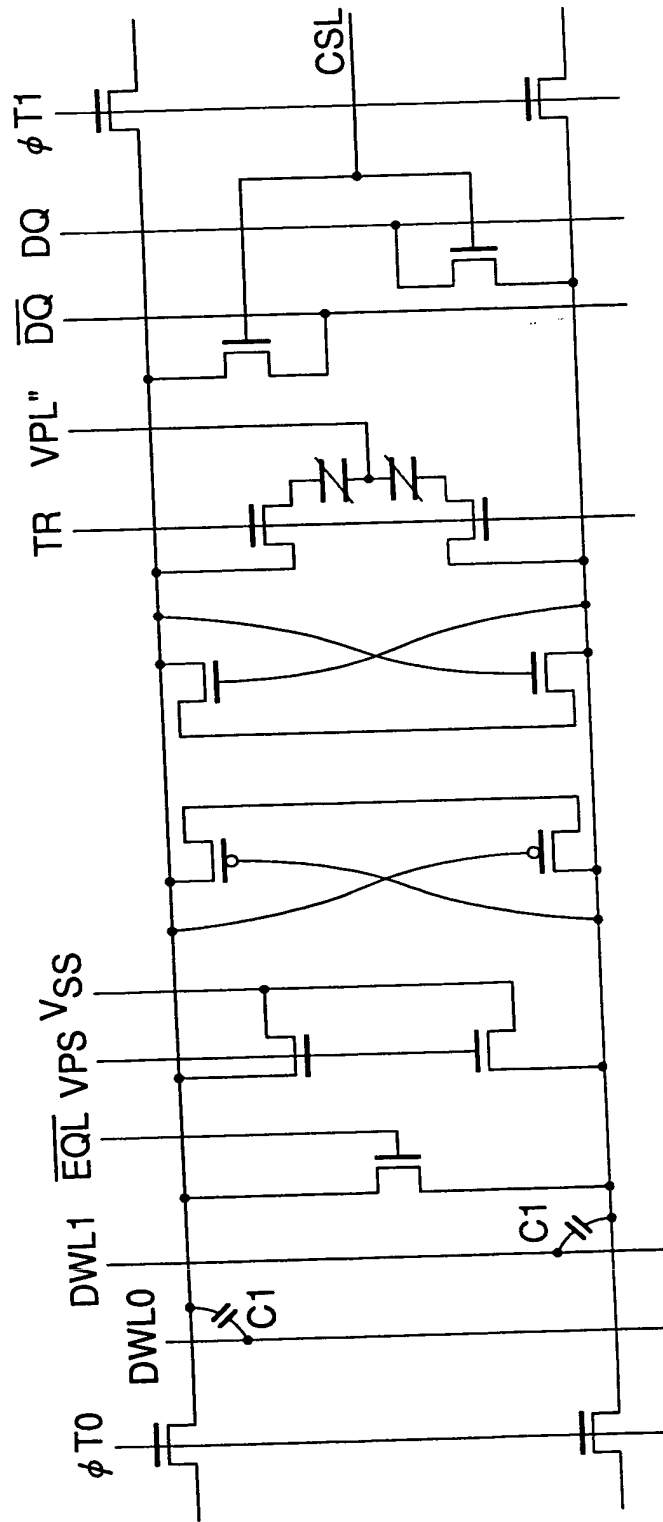


FIG. 114

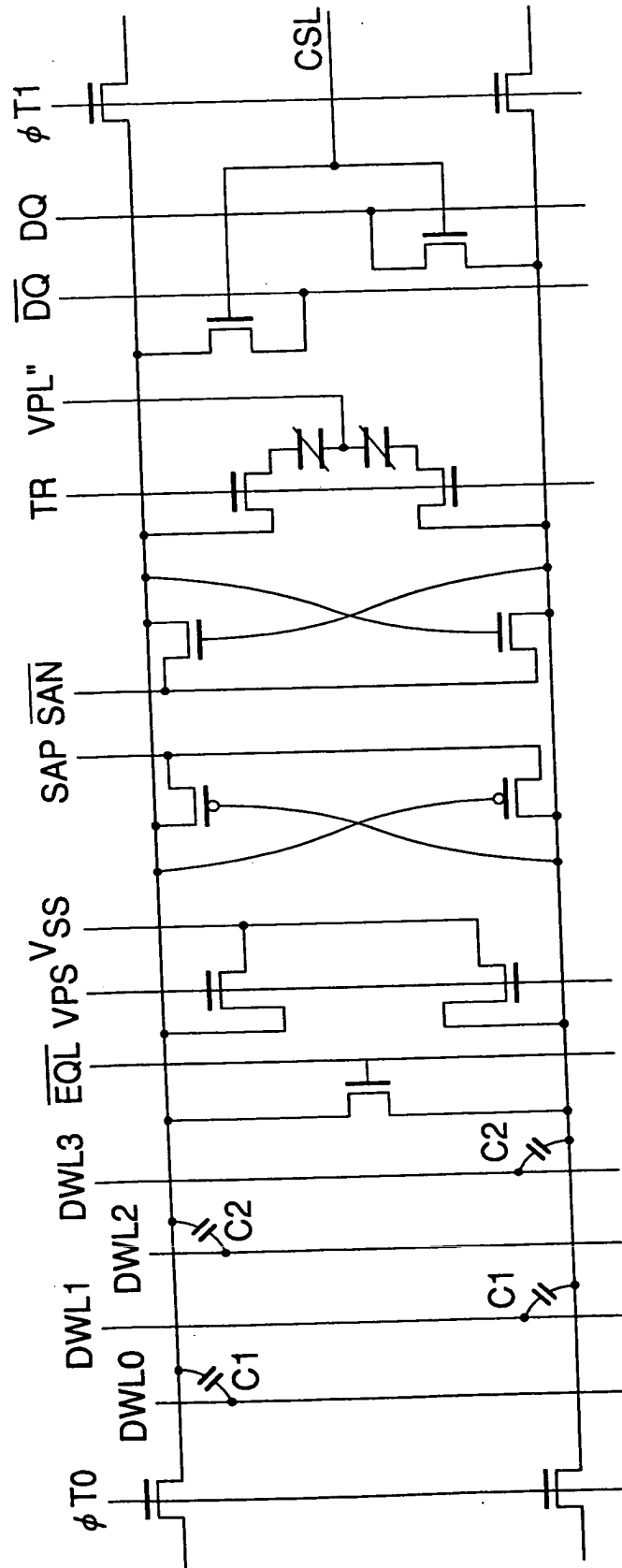


FIG. 115

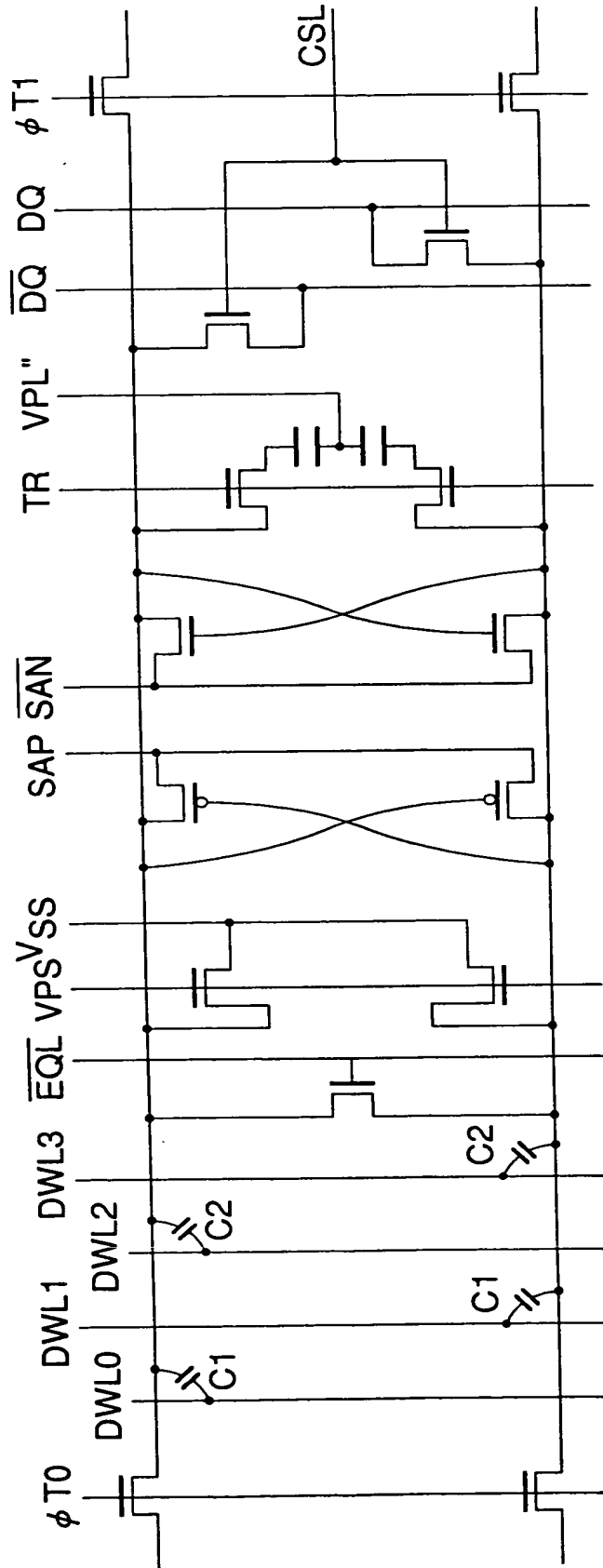


FIG. 116

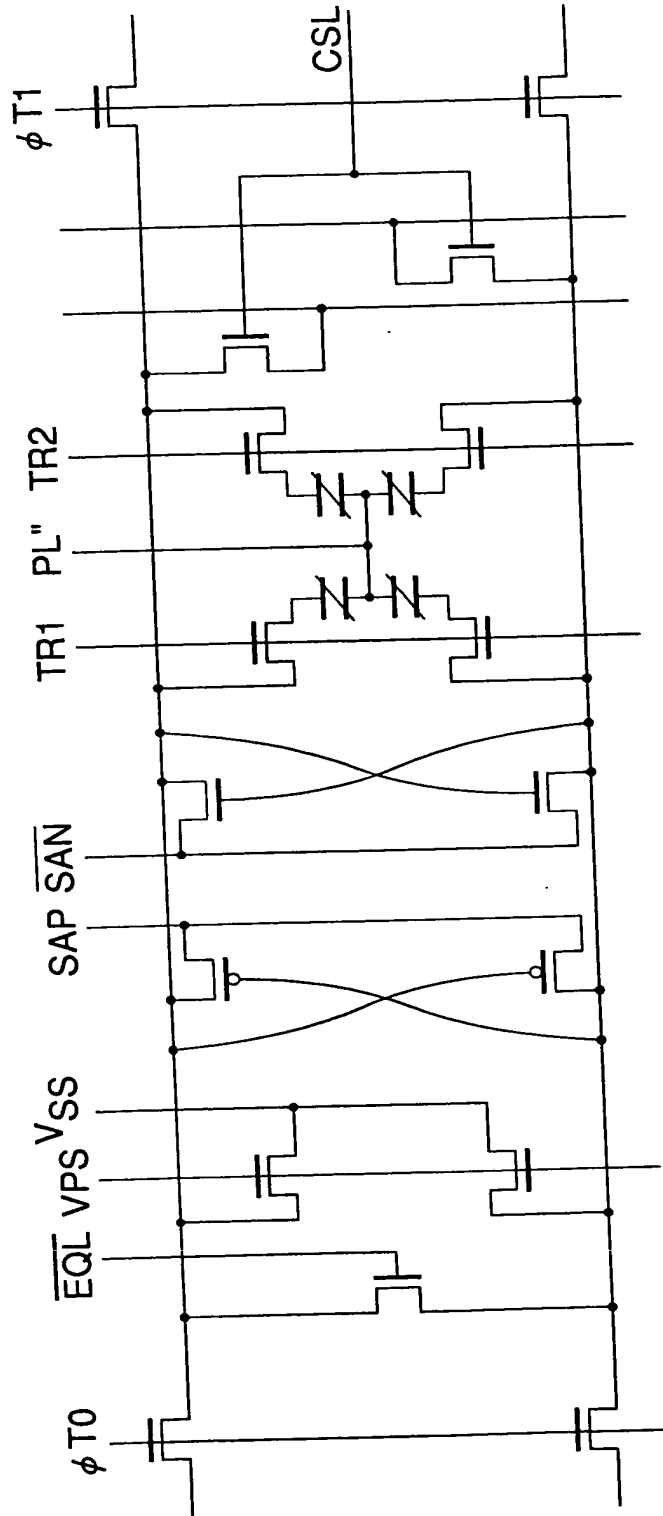


FIG. 117

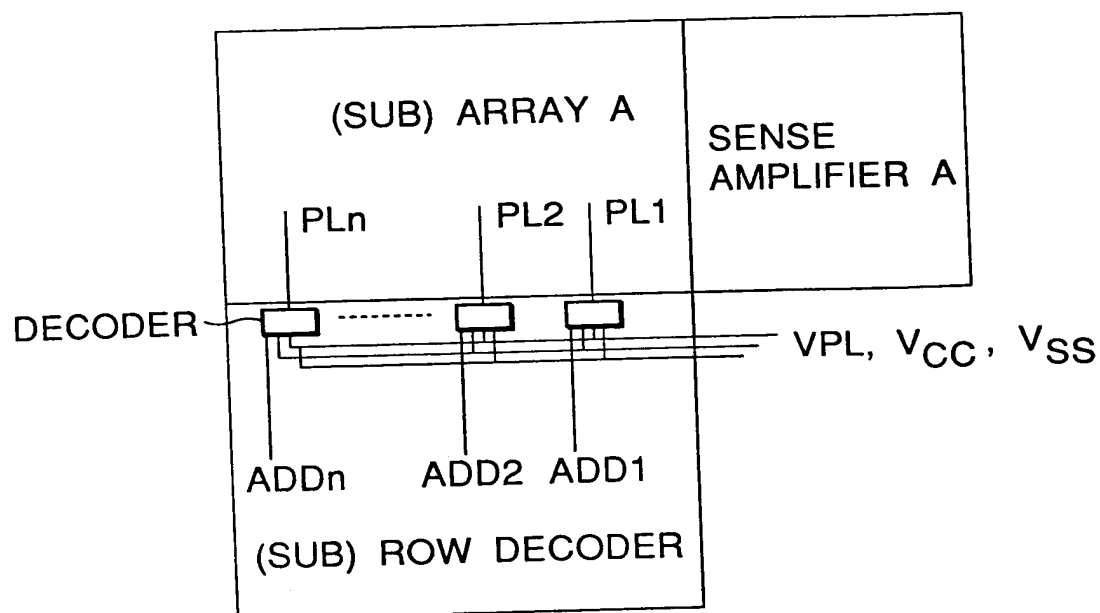


FIG.118

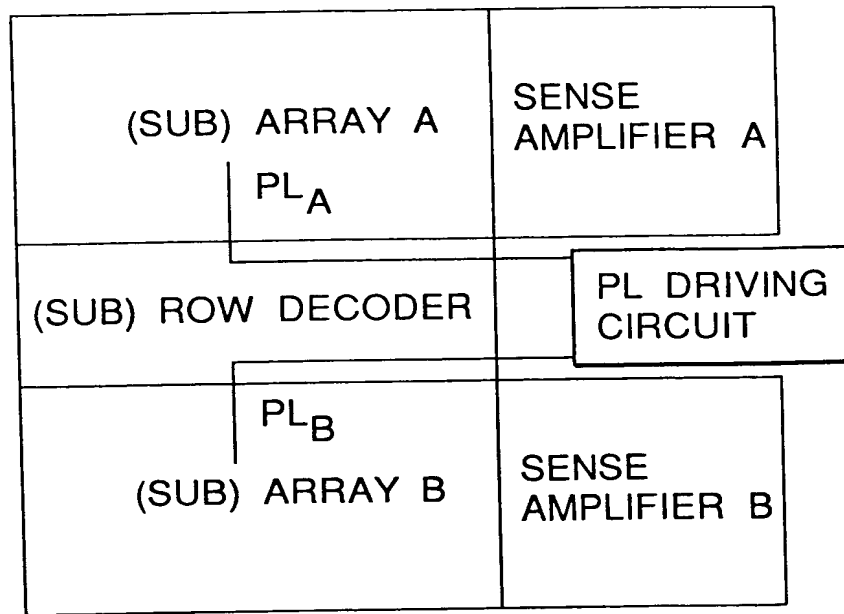


FIG. 119A

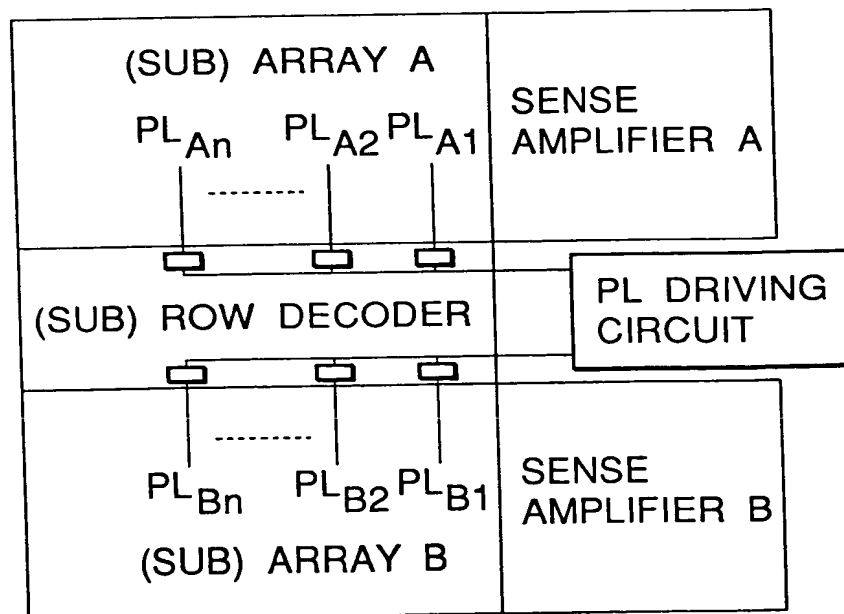


FIG. 119B

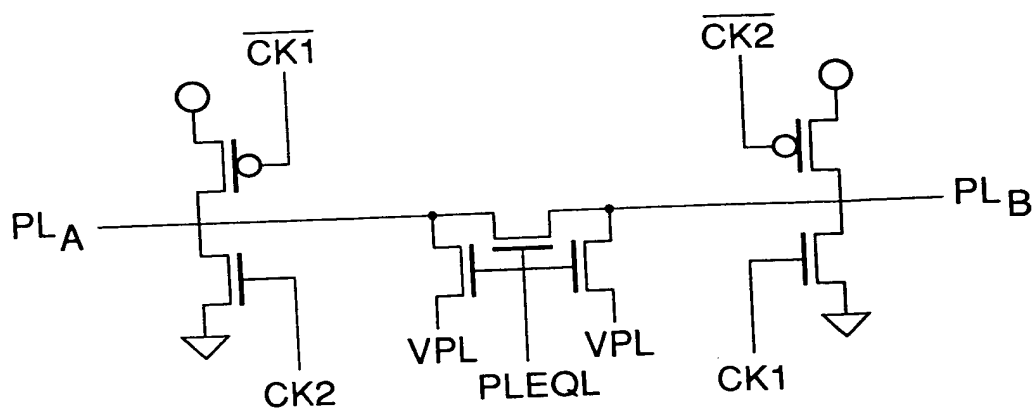
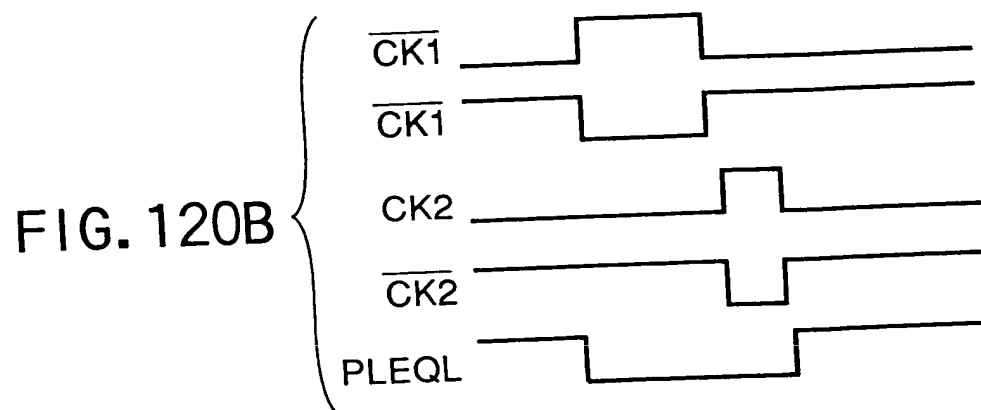


FIG. 120A



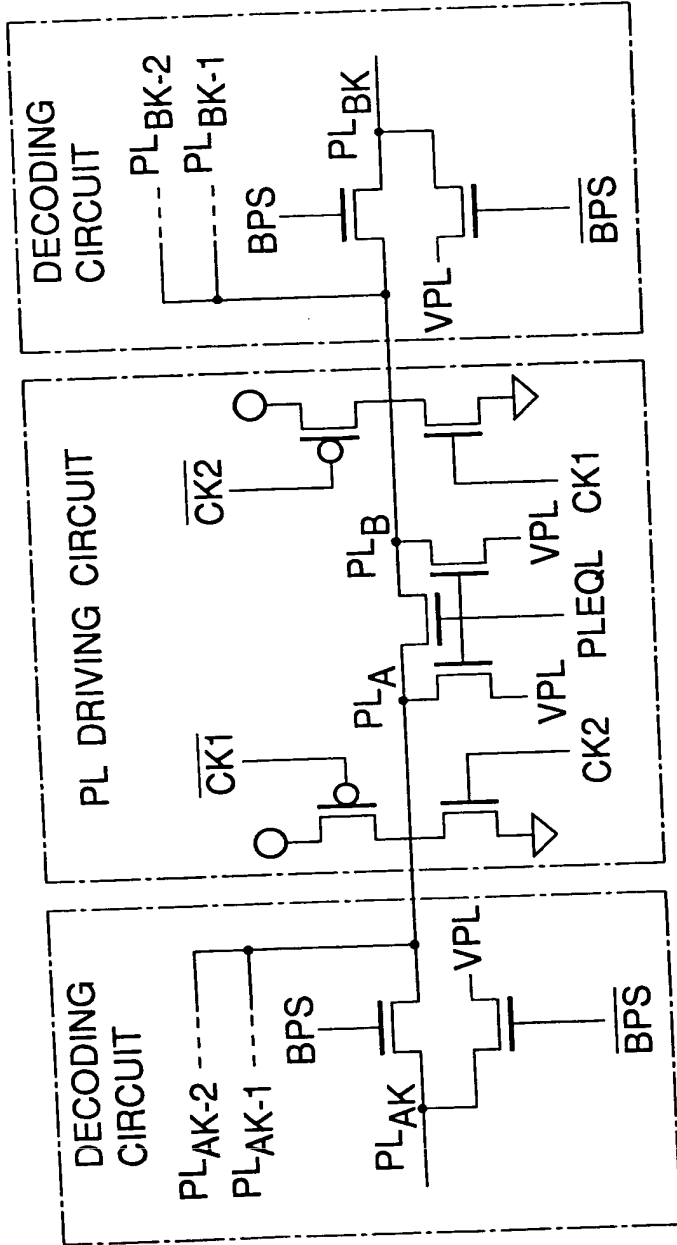
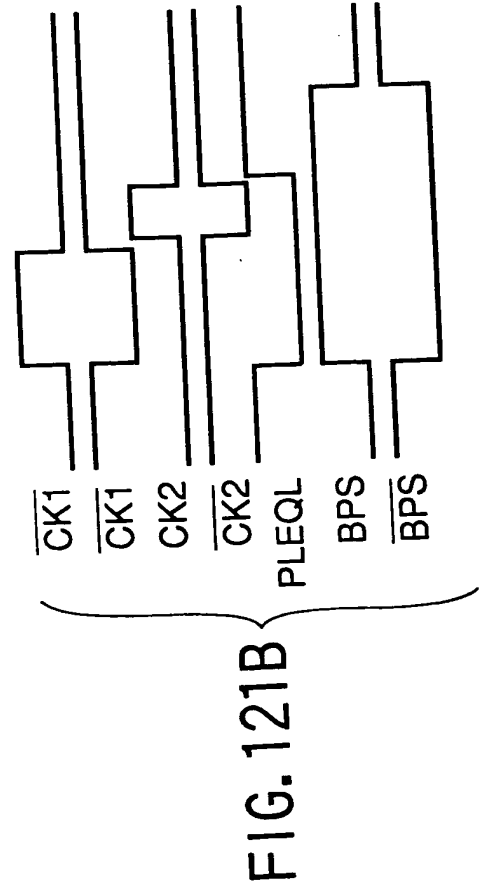


FIG. 121A



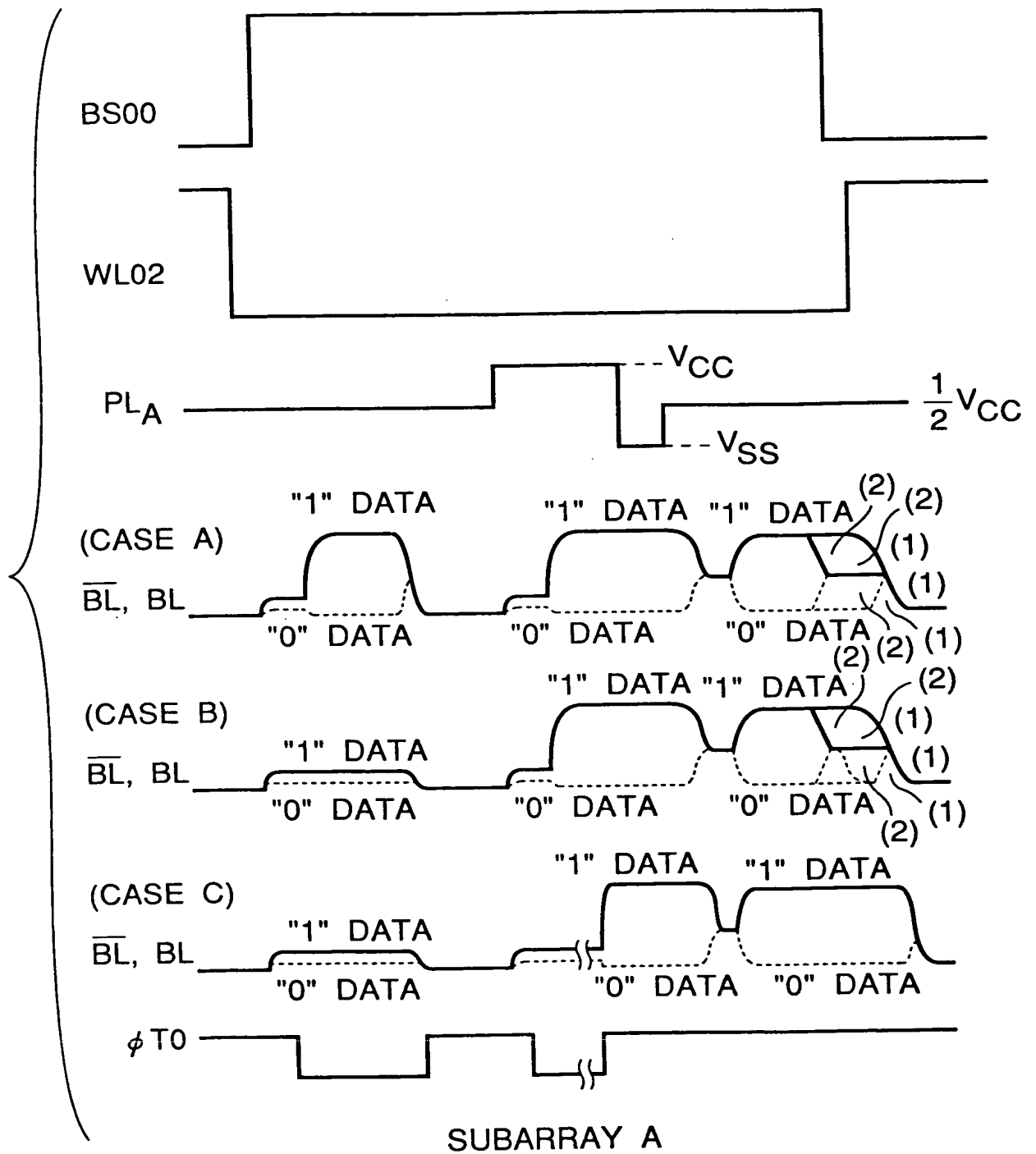
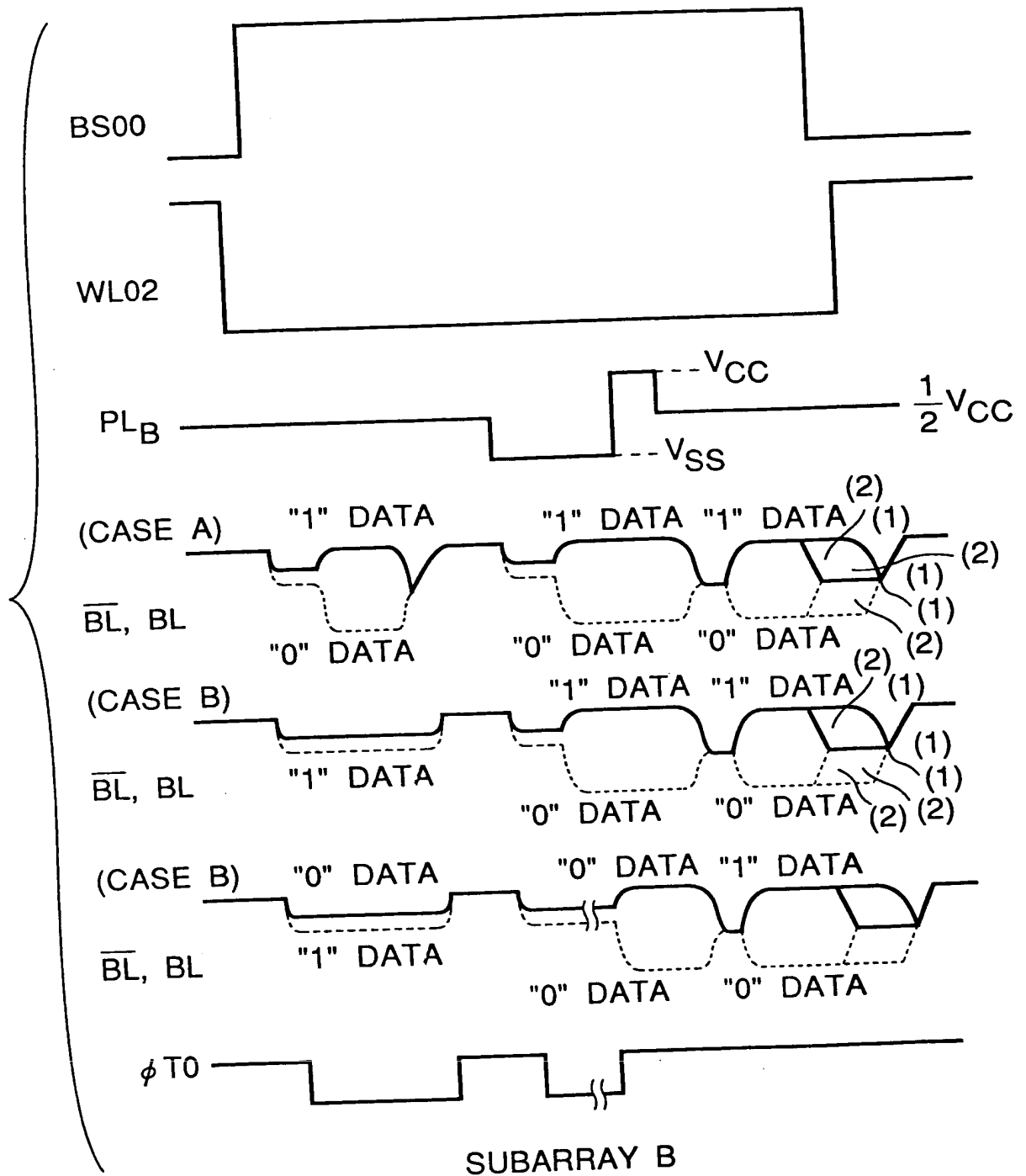


FIG.122A



SUBARRAY B

FIG. 122B

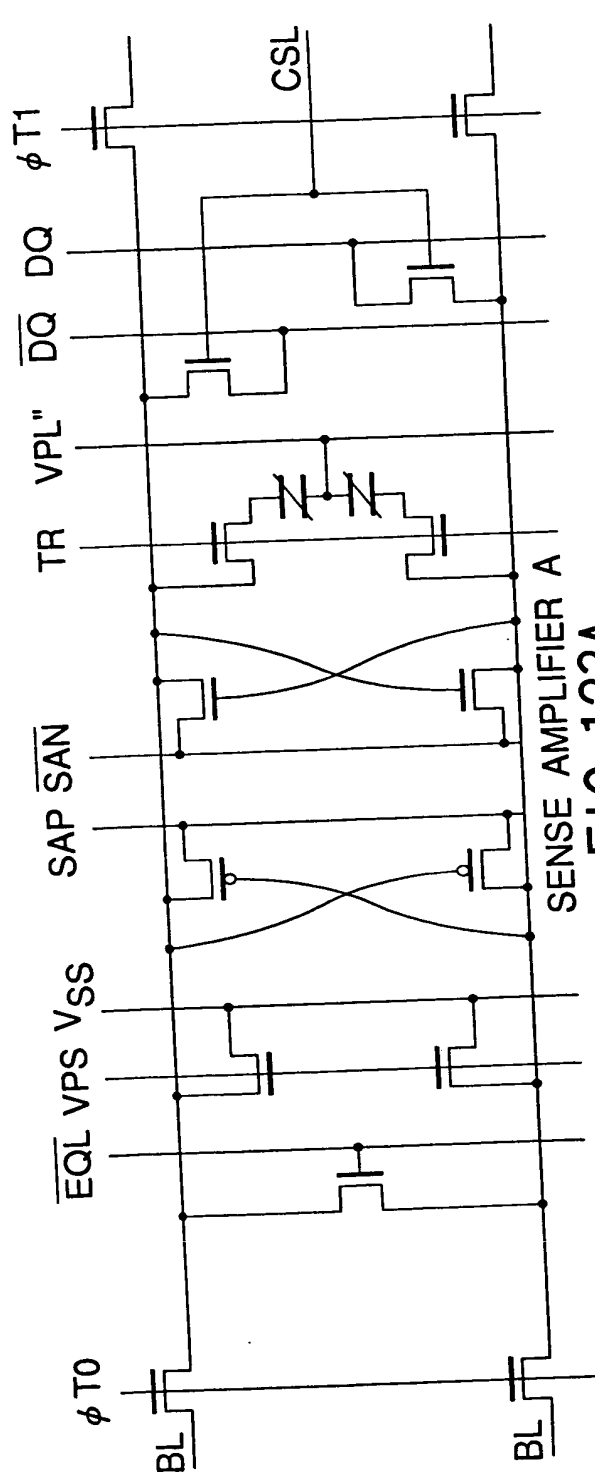


FIG. 123A

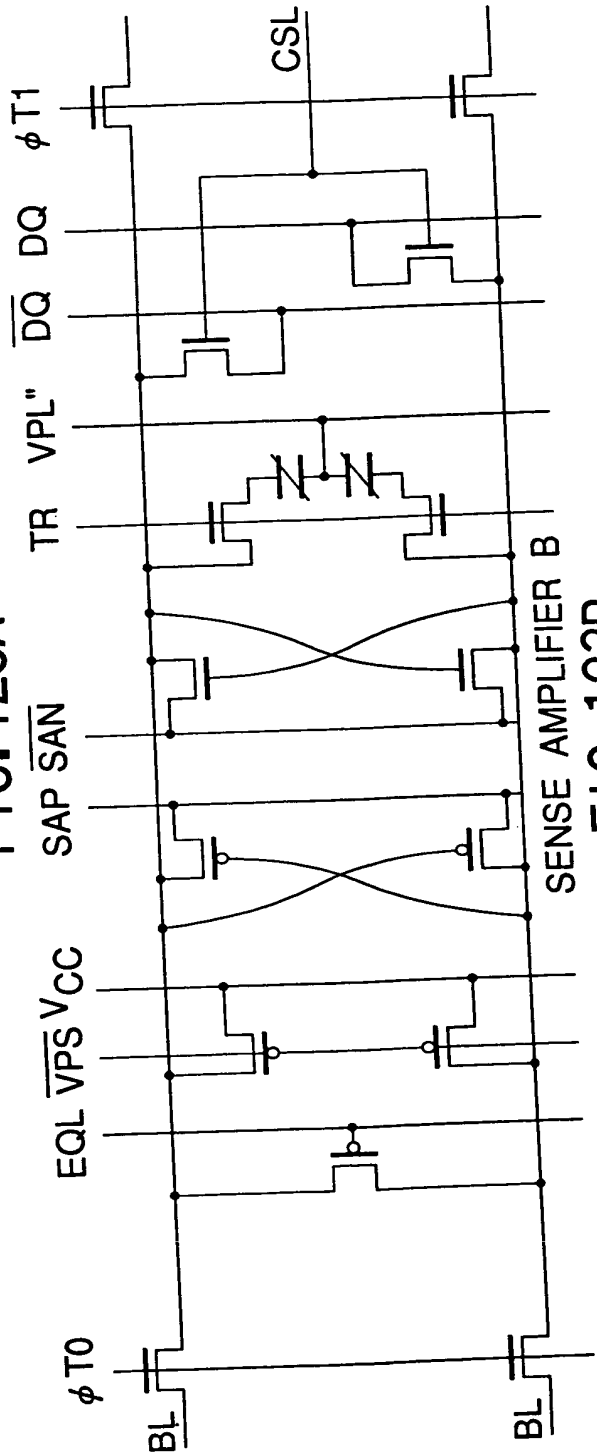


FIG. 123B

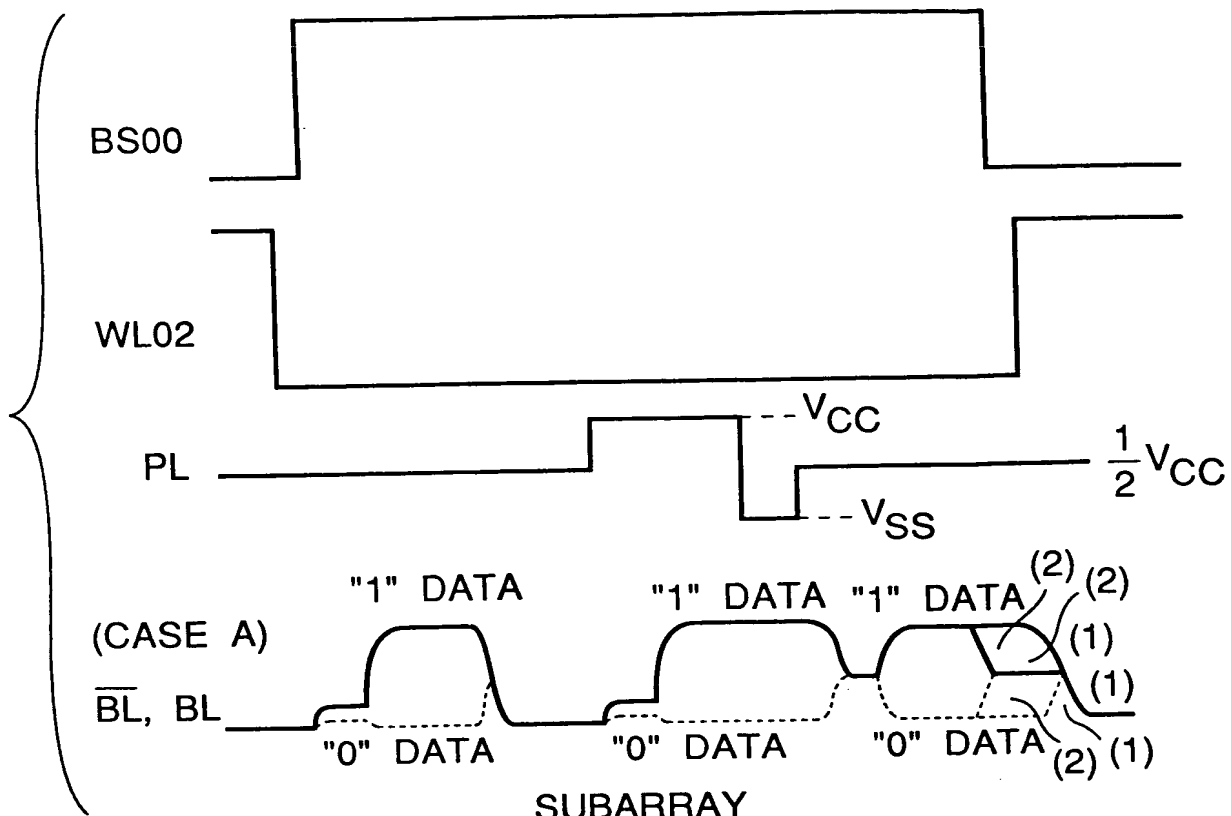


FIG. 124A

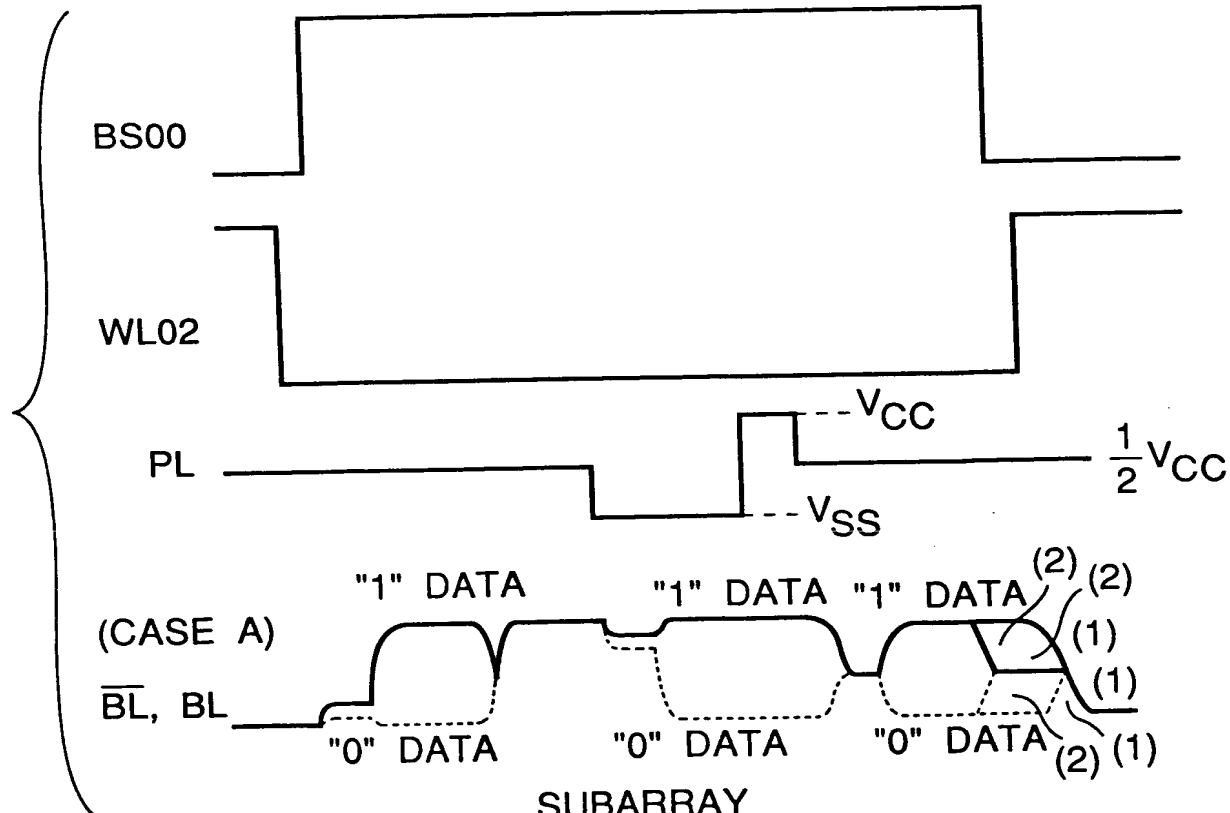


FIG. 124B

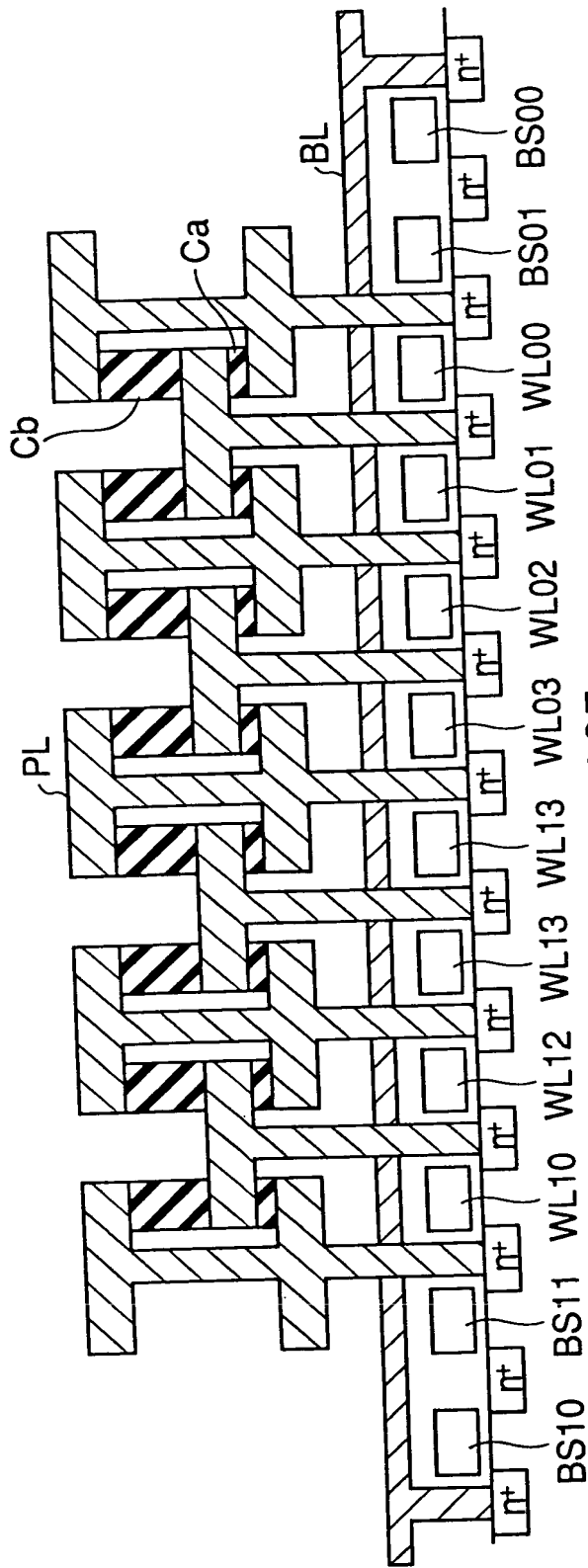


FIG. 125

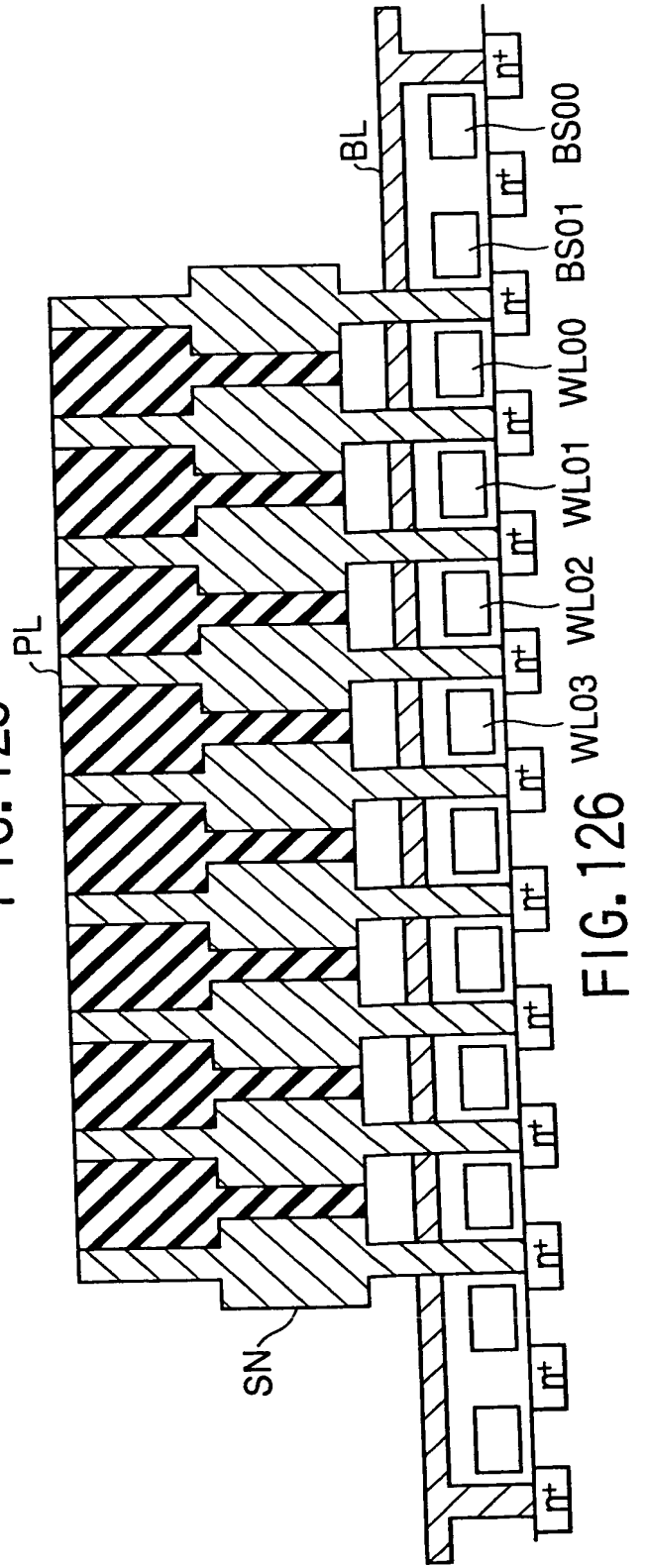


FIG. 126

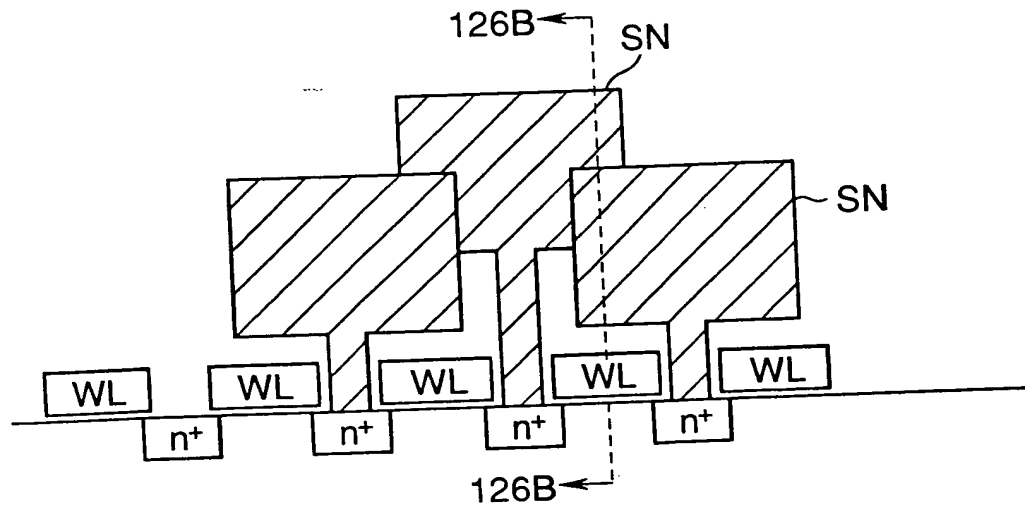
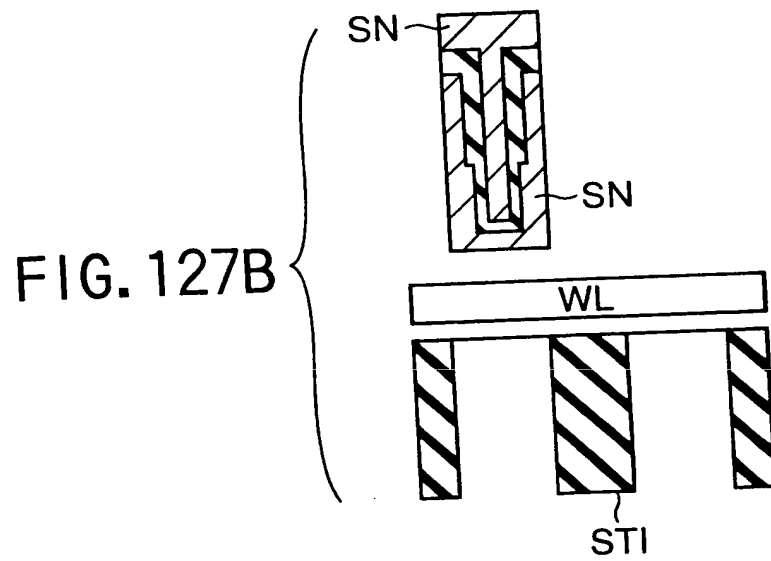


FIG. 127A



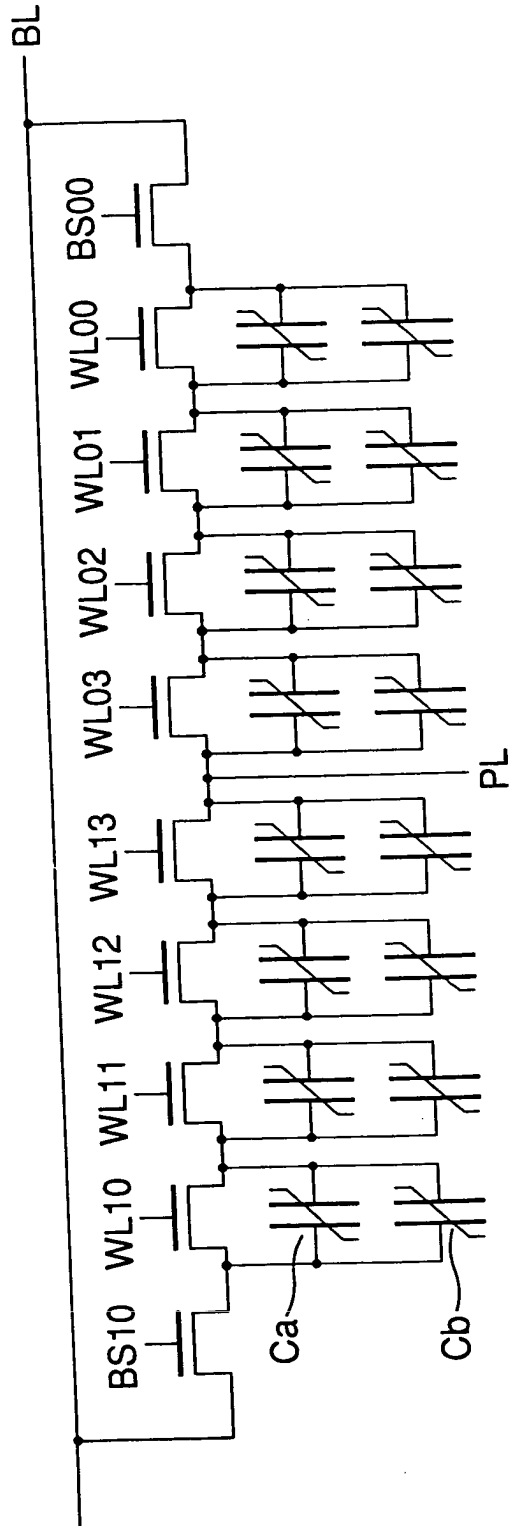


FIG. 128A

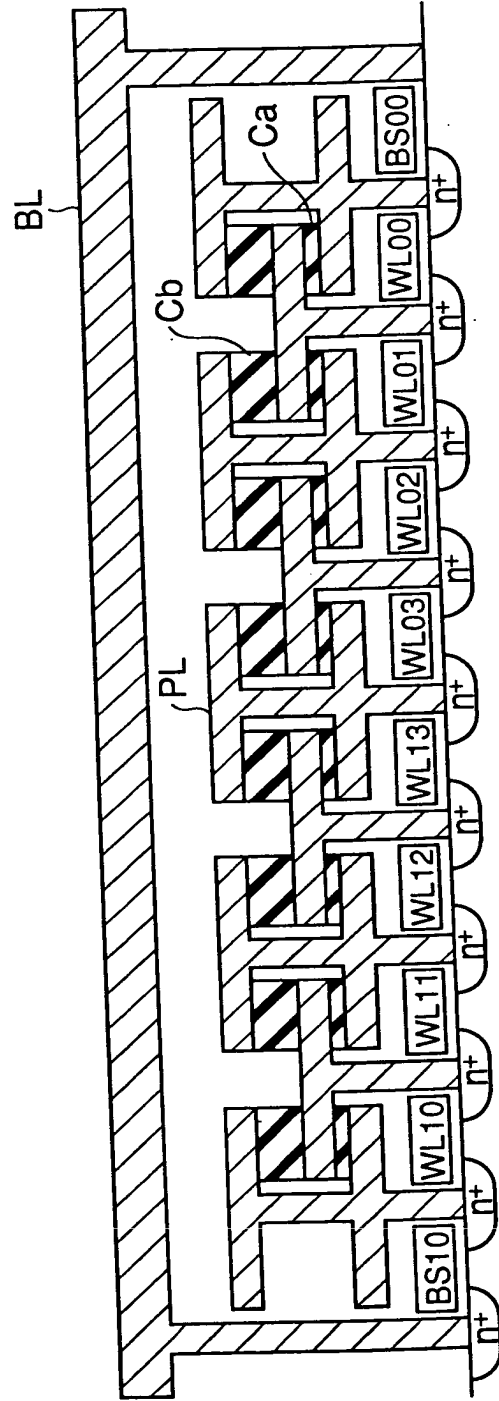


FIG. 128B

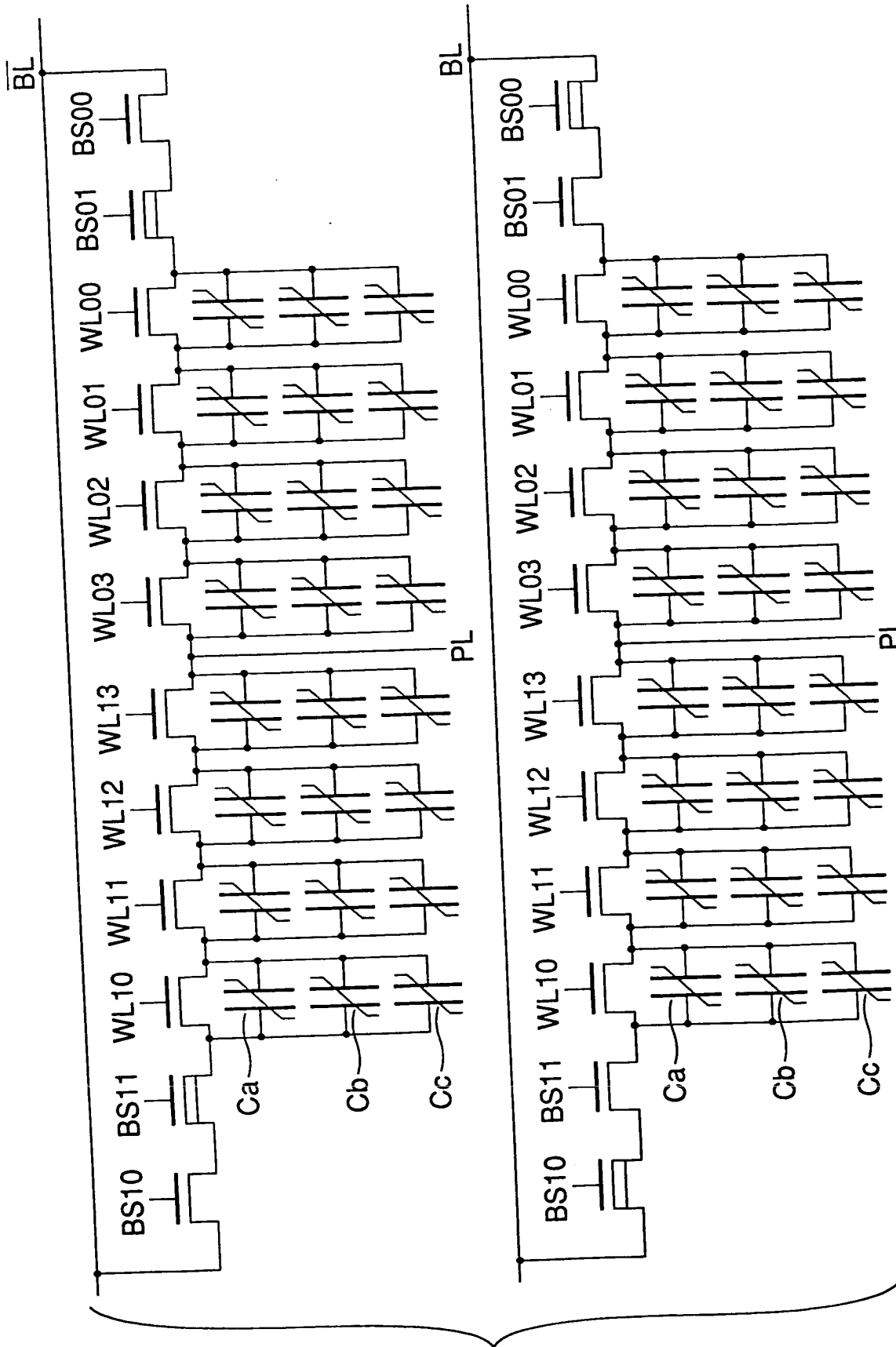


FIG. 129

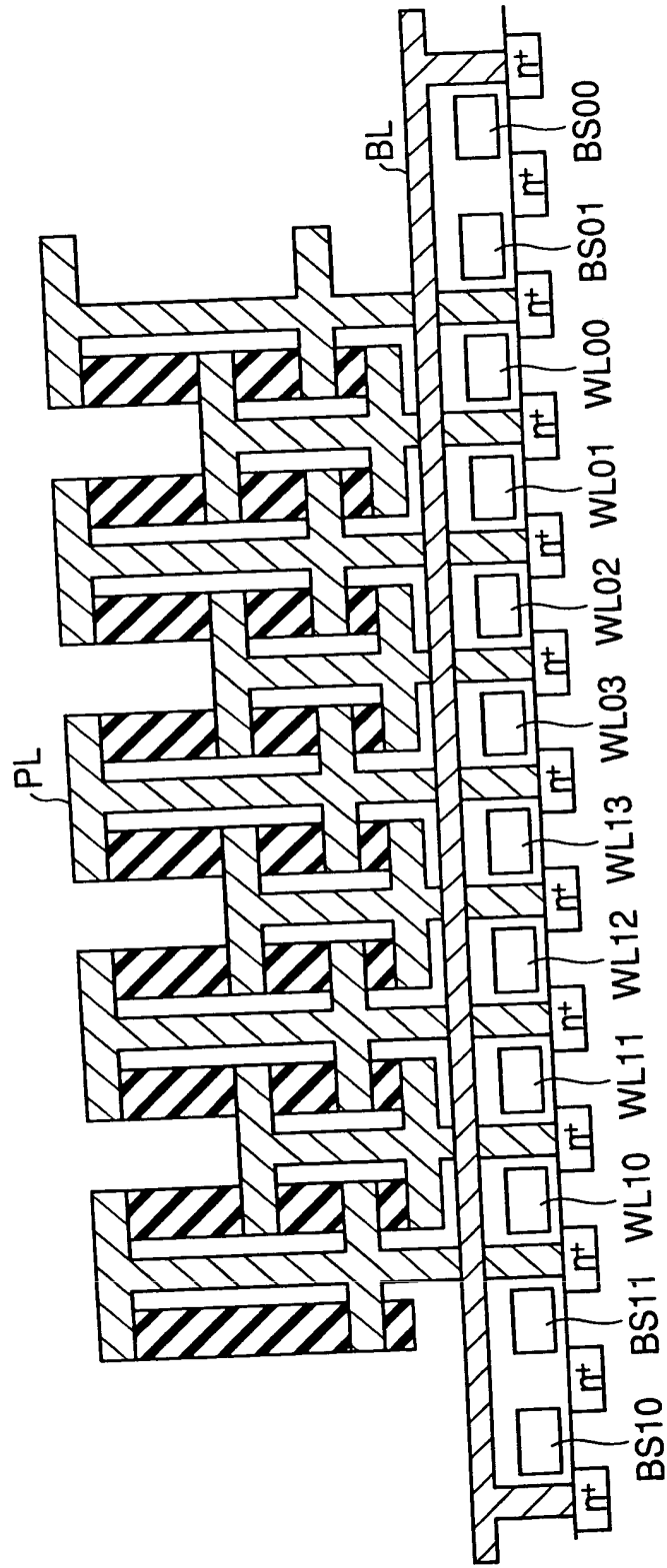


FIG. 130

FIG. 131

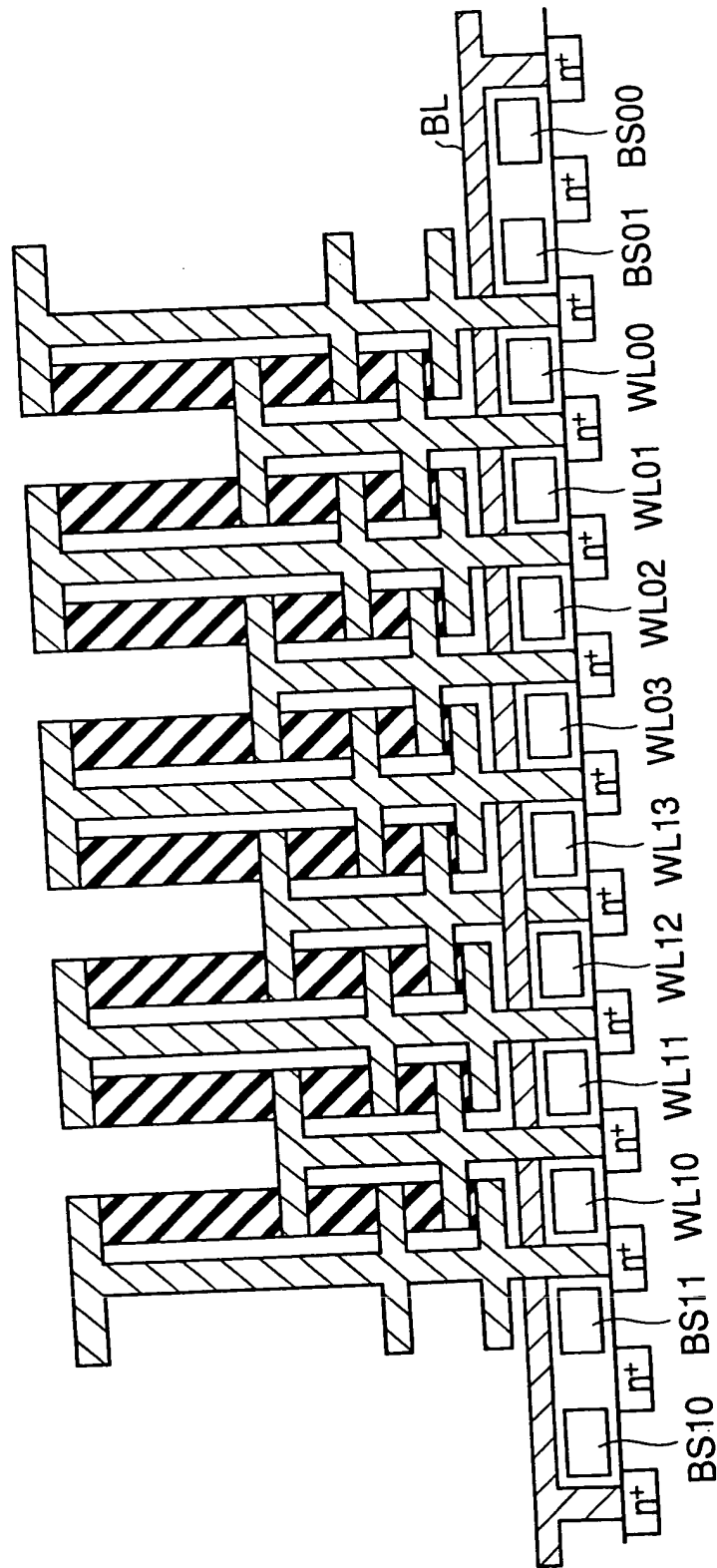


FIG. 132

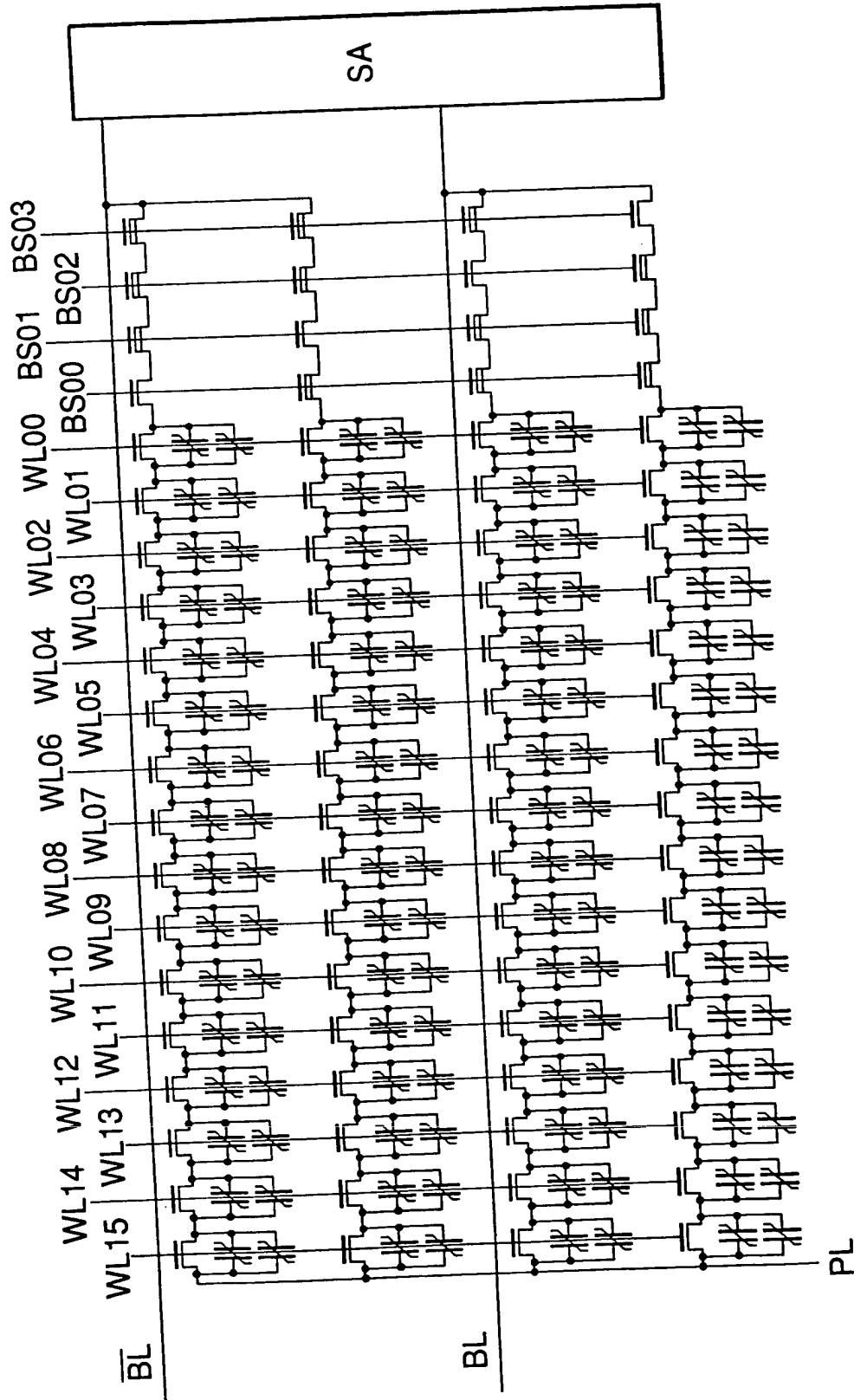


FIG. 133

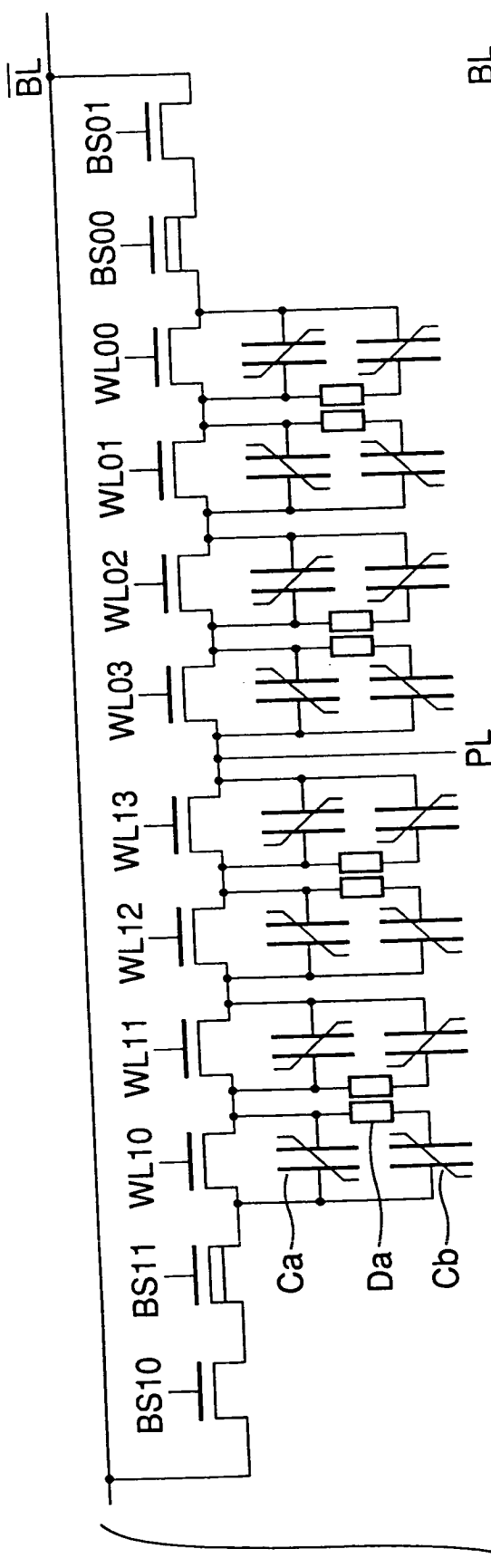


FIG. 134A

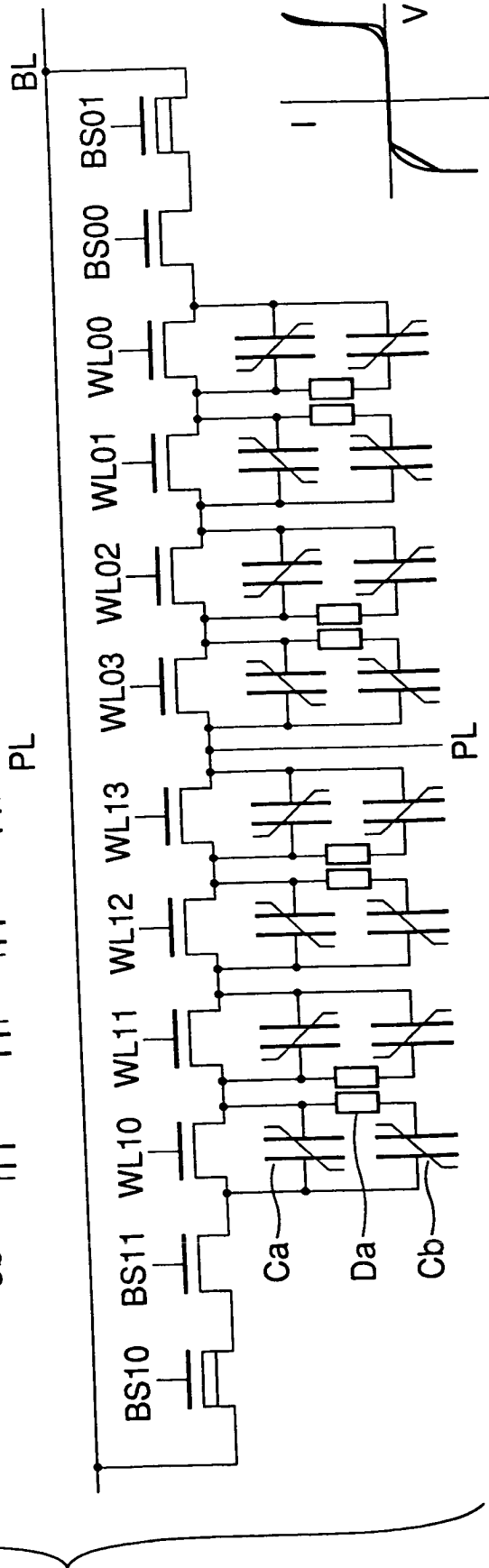
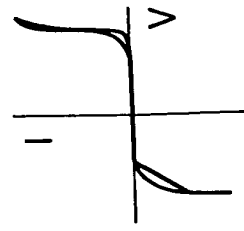


FIG. 134B



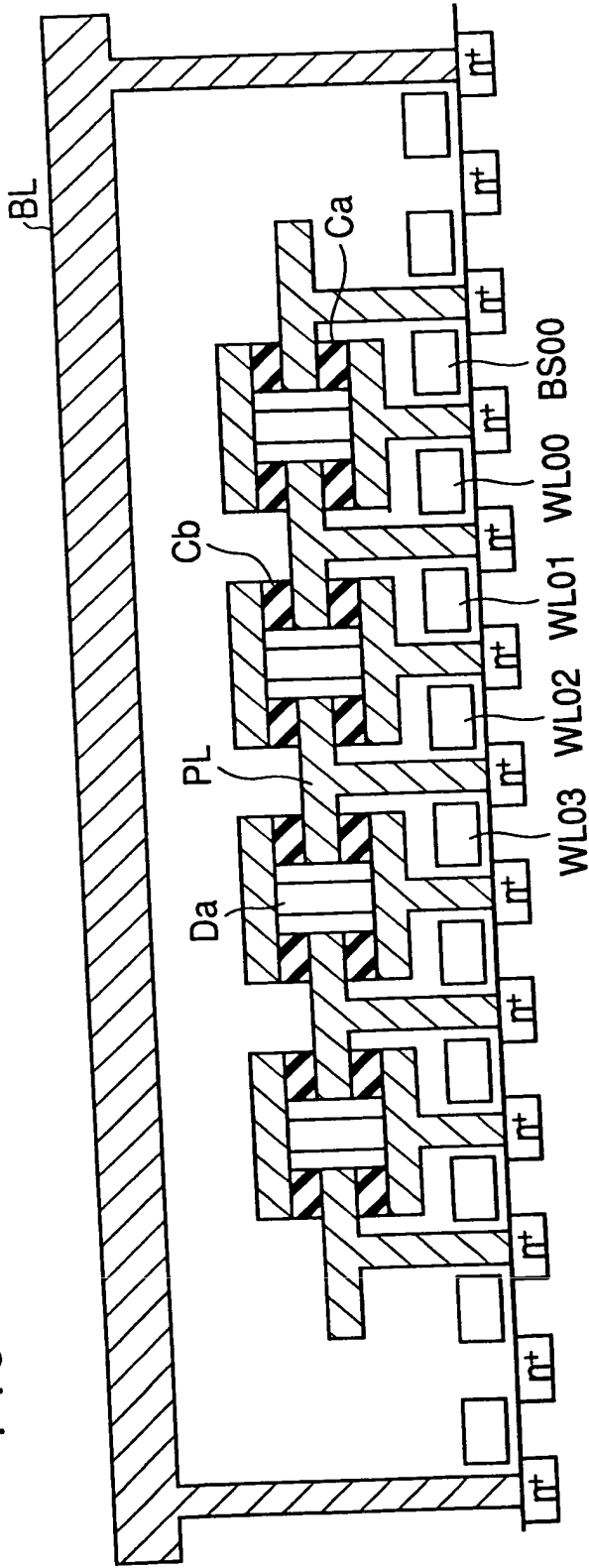
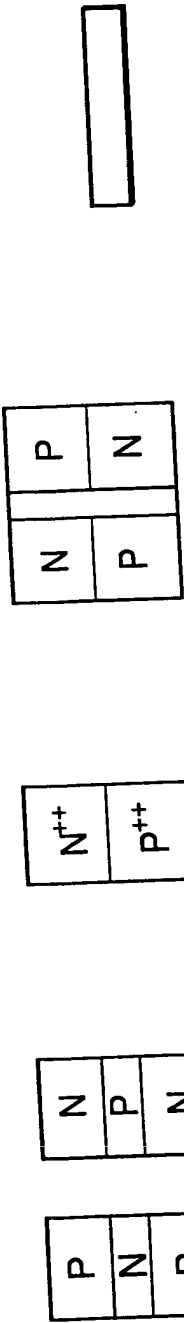


FIG. 136

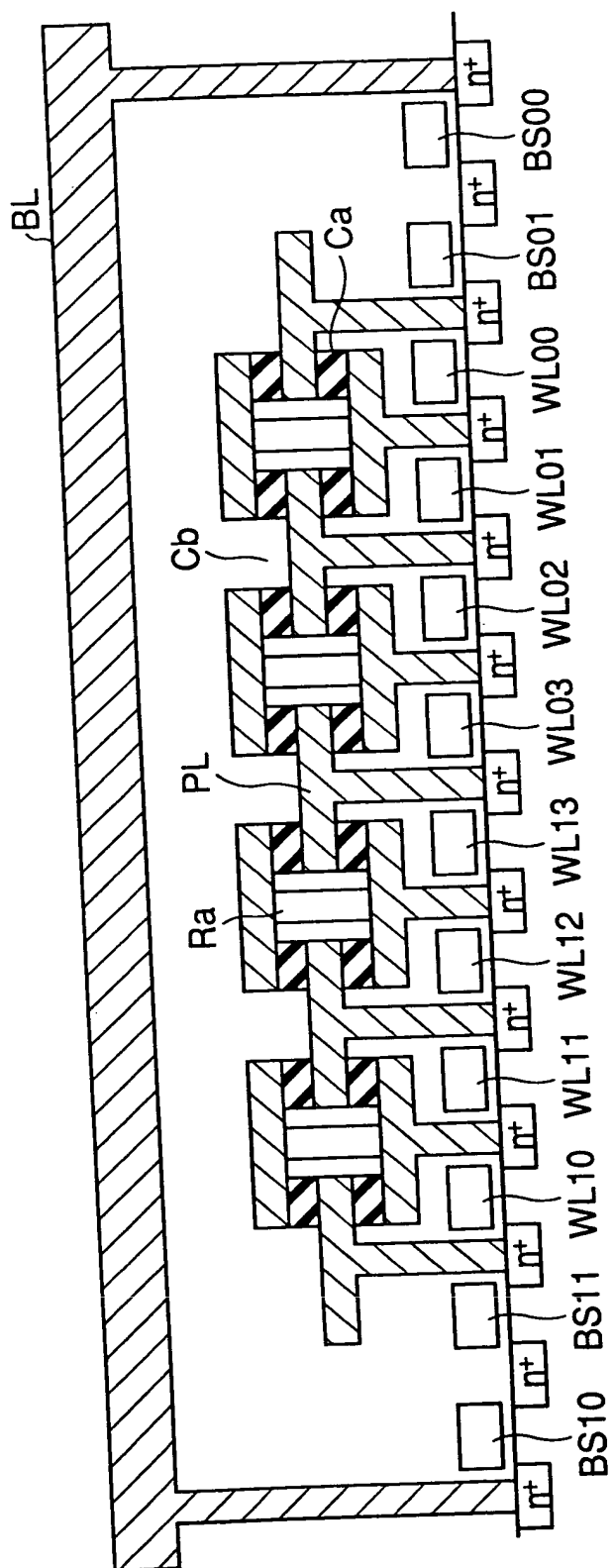


FIG. 137

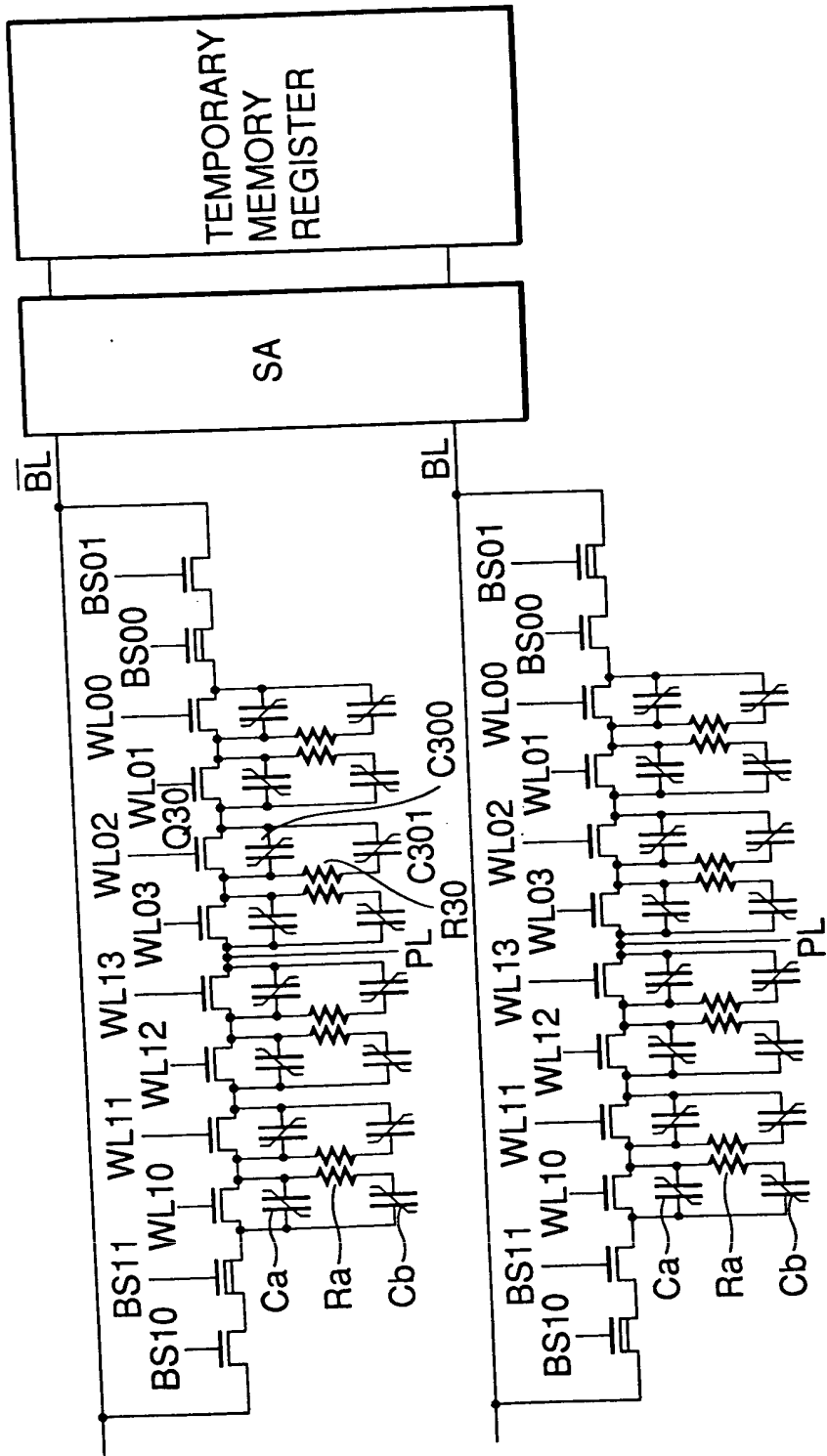


FIG. 138

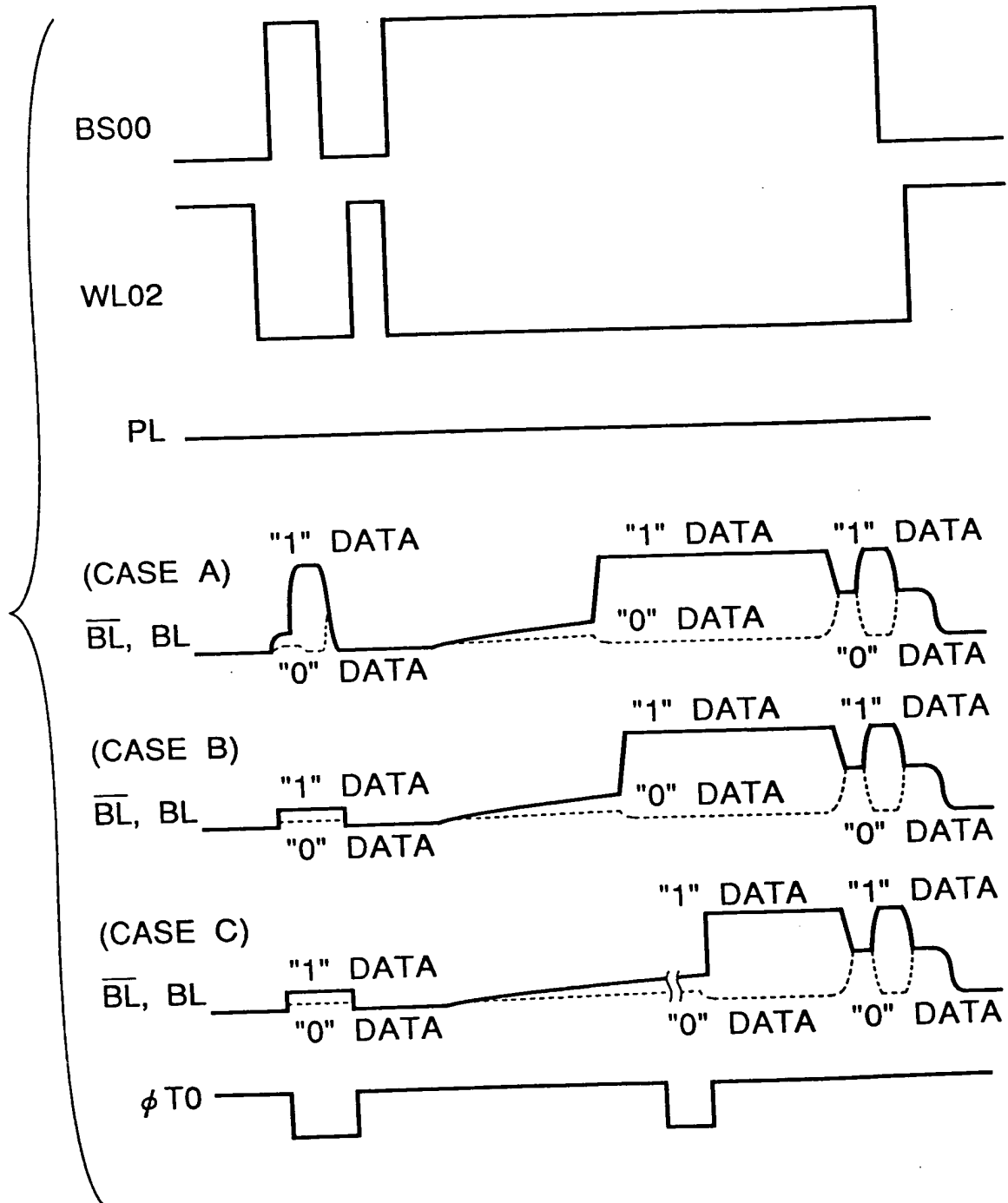


FIG. 139

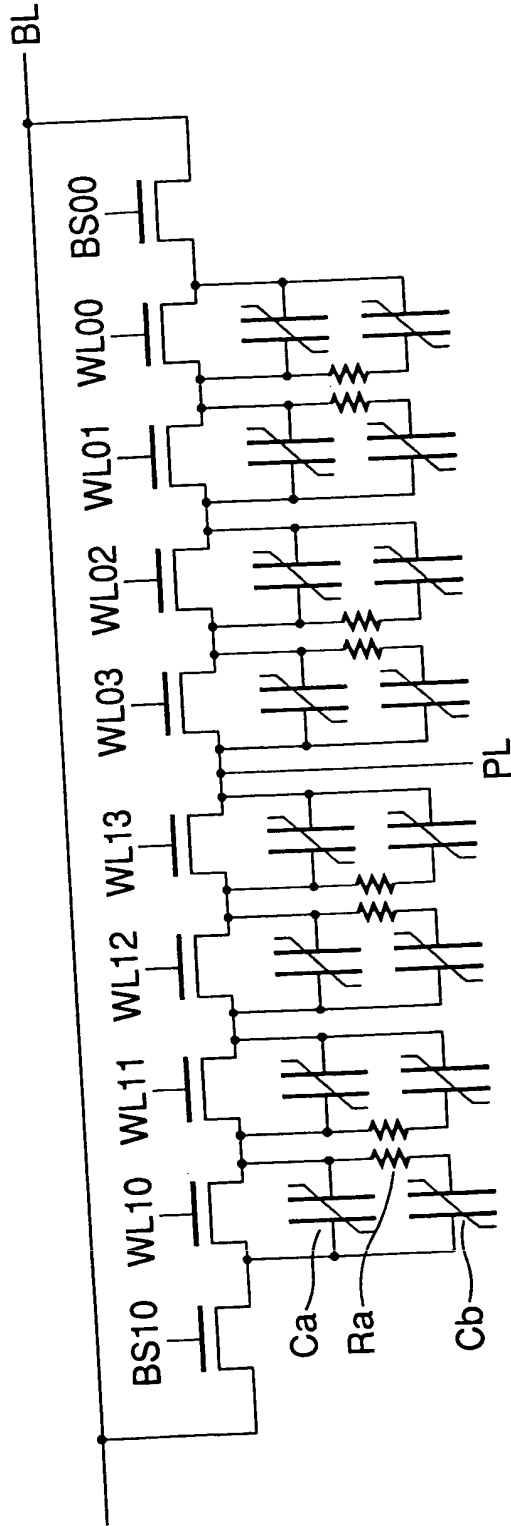


FIG. 140A

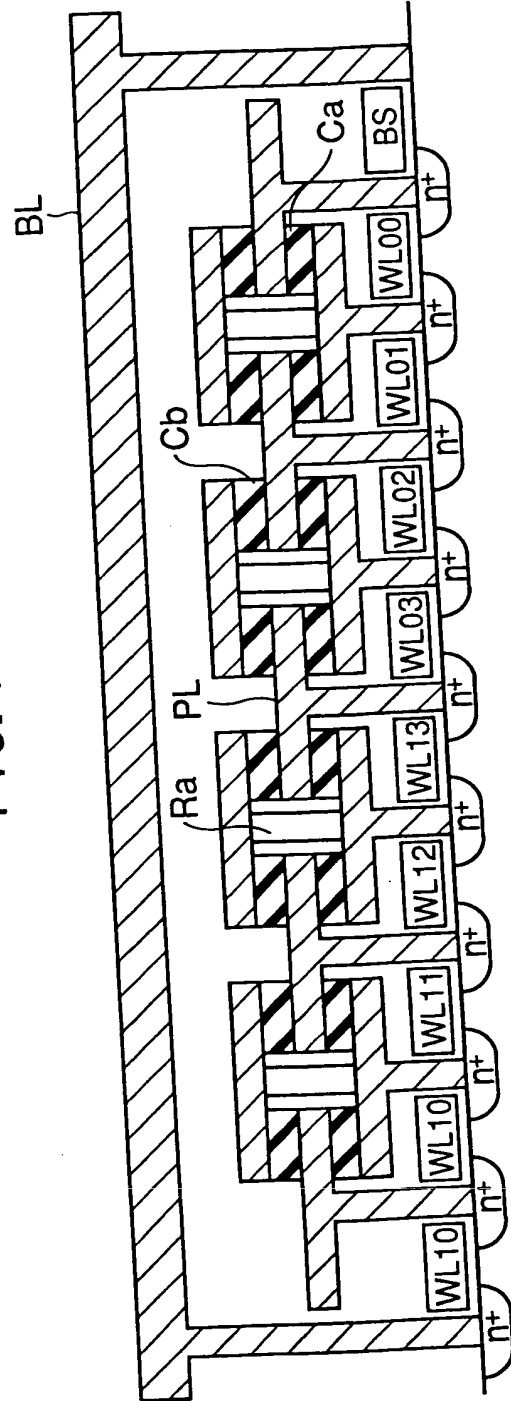


FIG. 140B

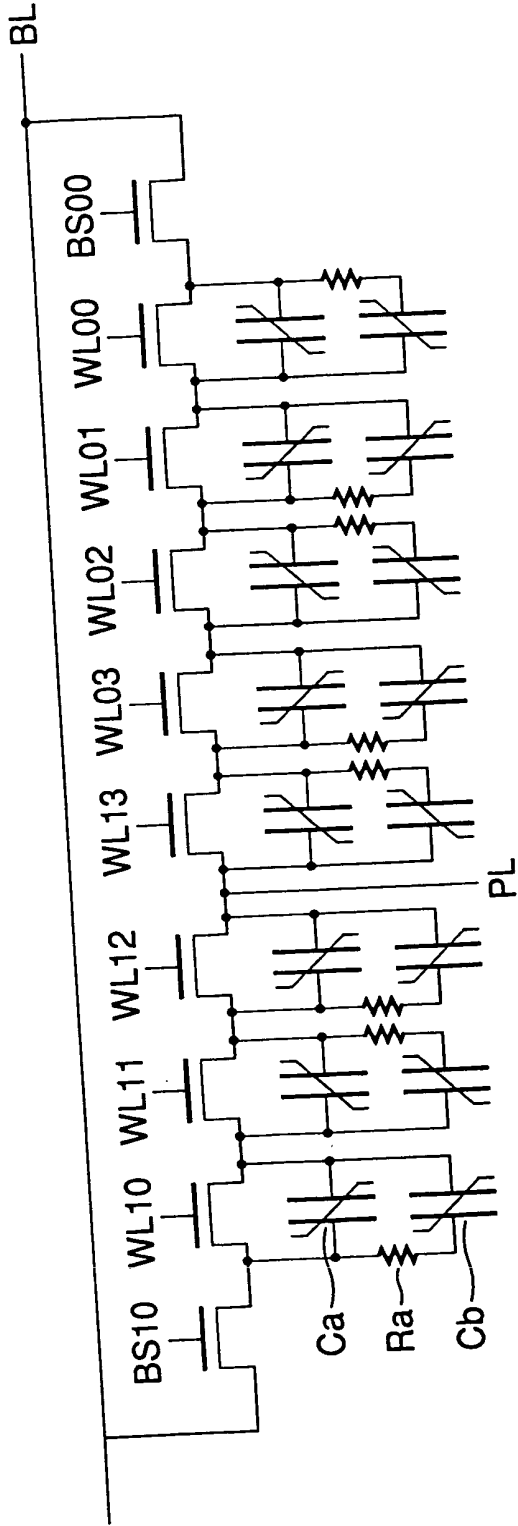


FIG. 141A

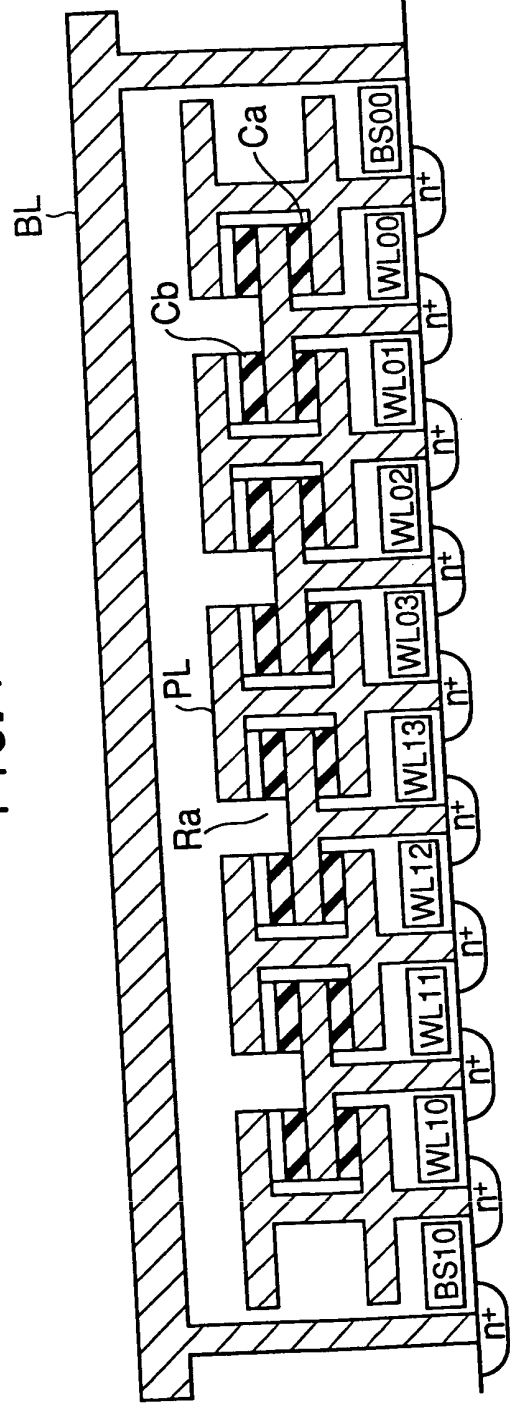


FIG. 141B

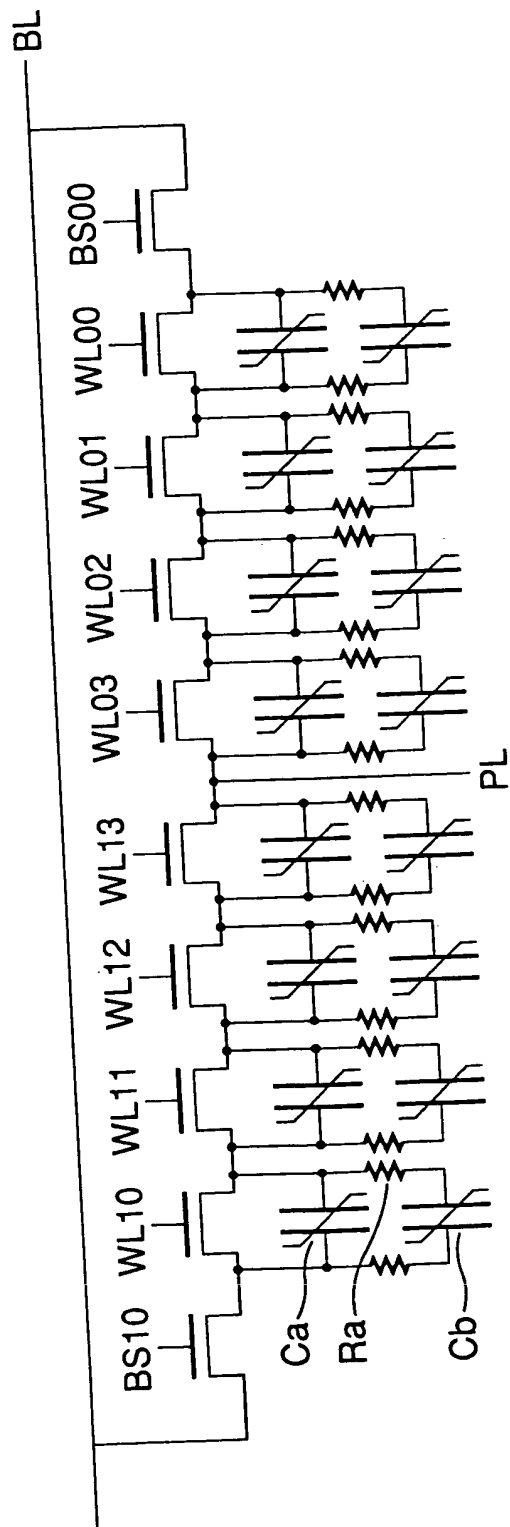


FIG. 142A

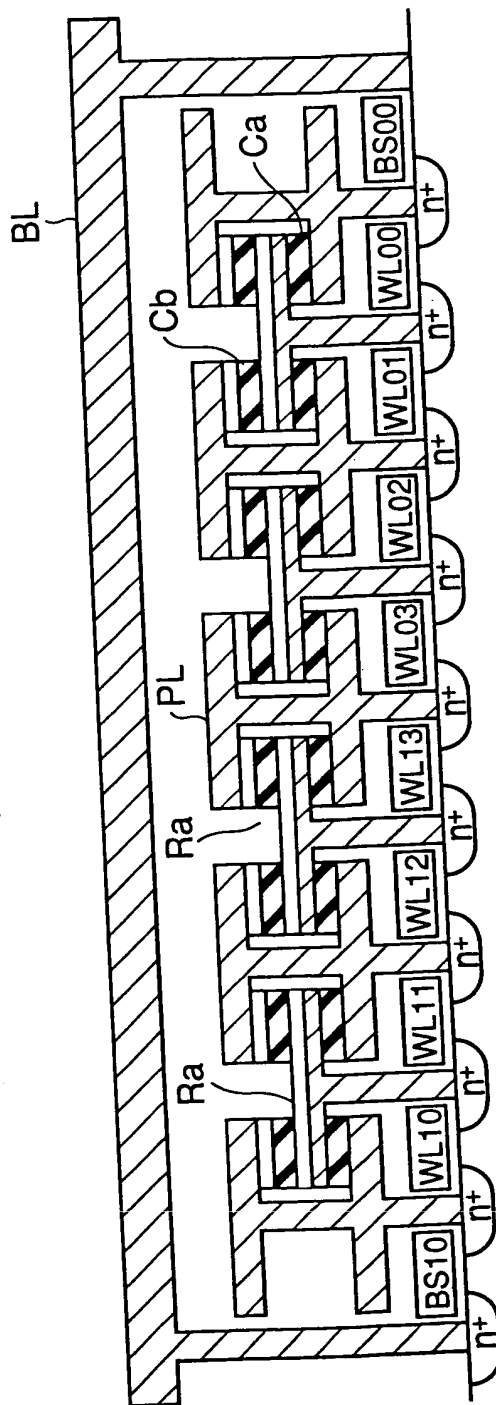


FIG. 142B

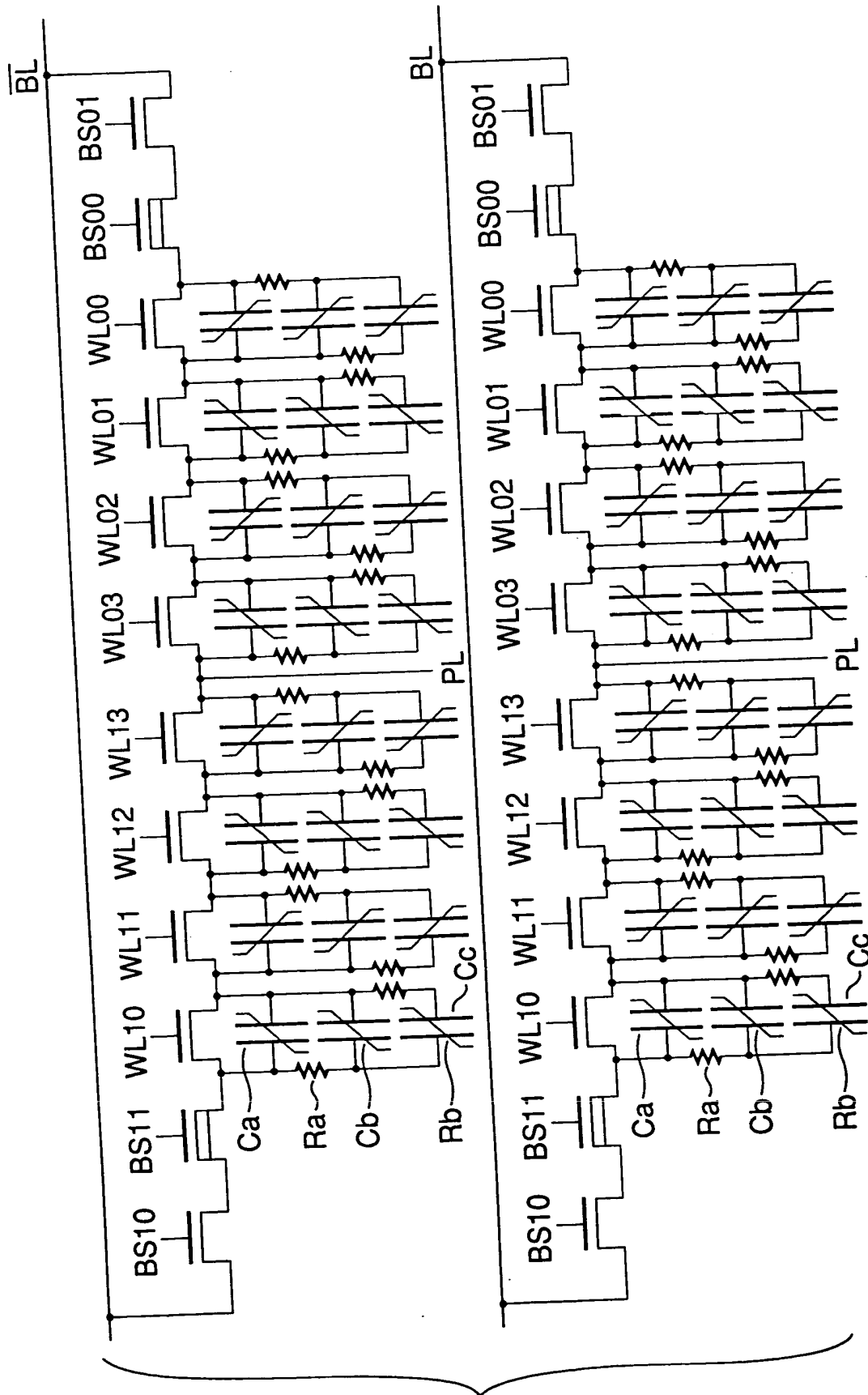


FIG. 143

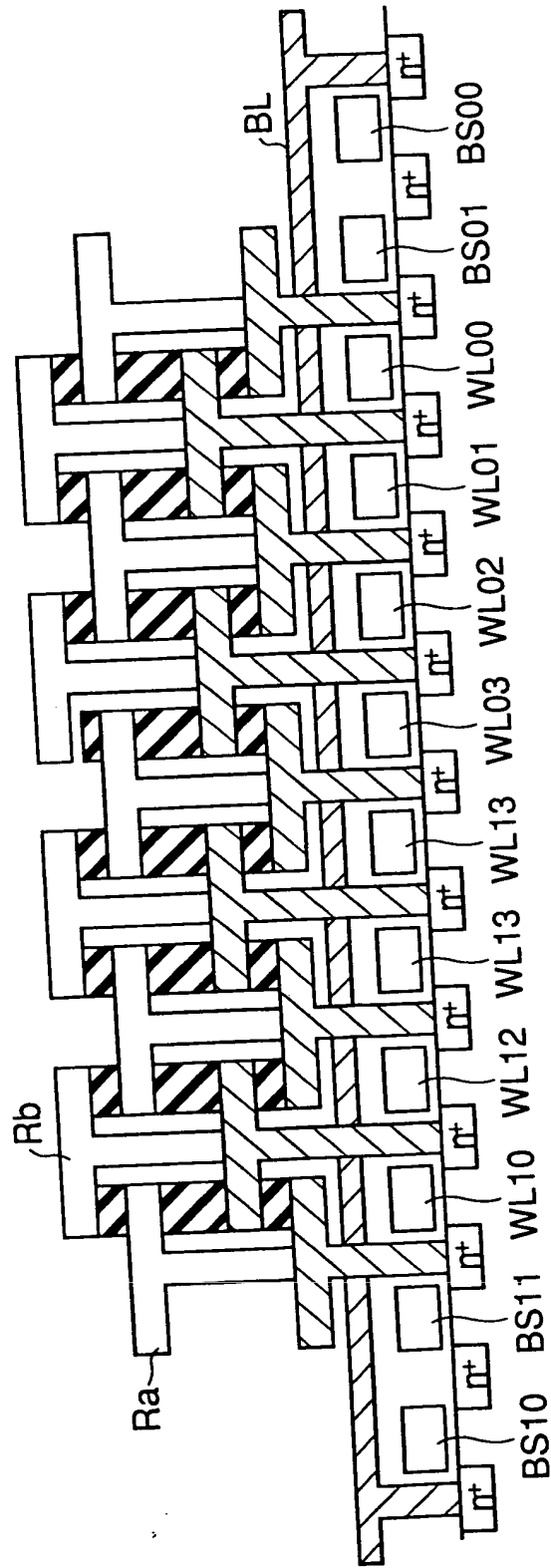


FIG. 144

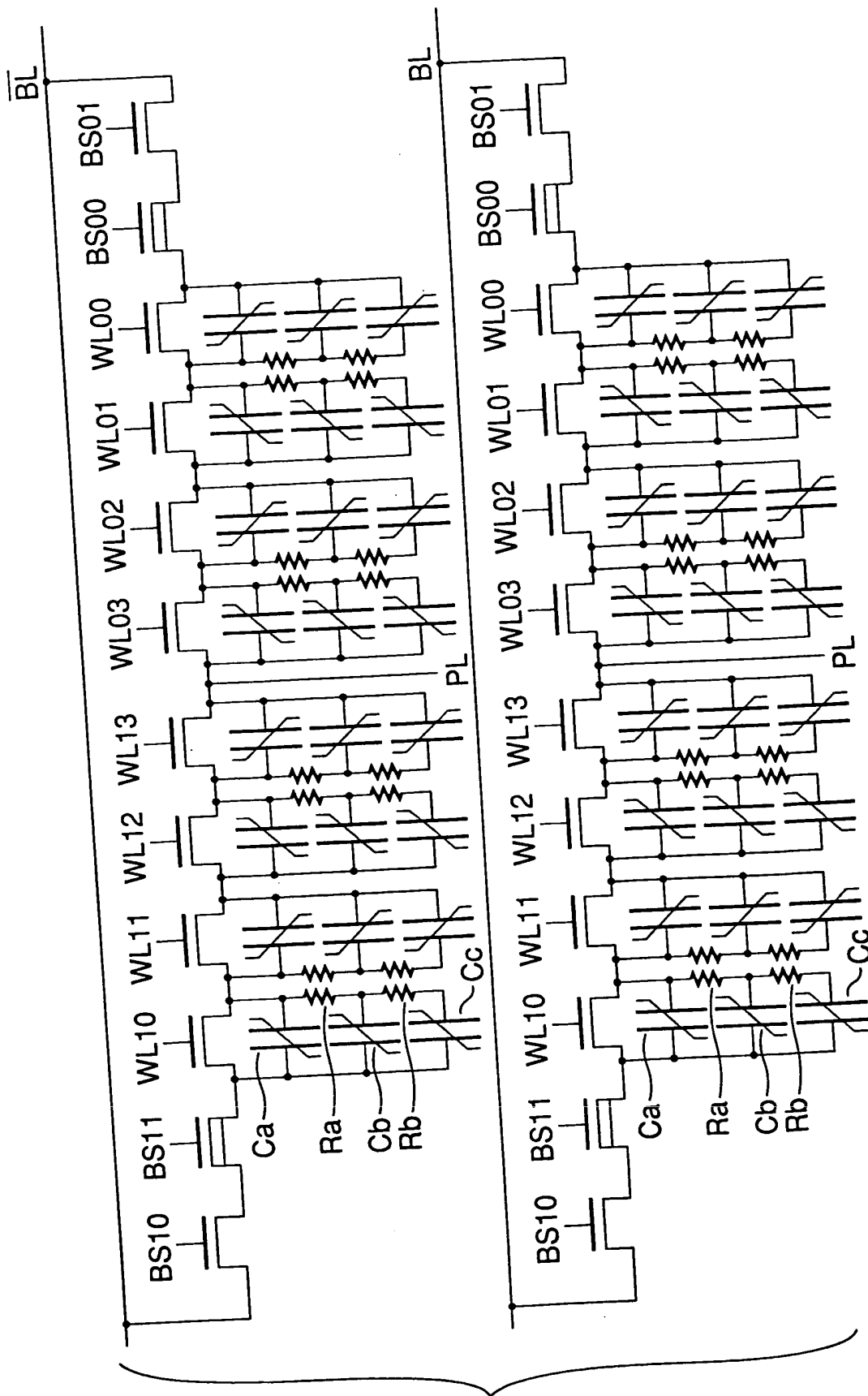


FIG. 145

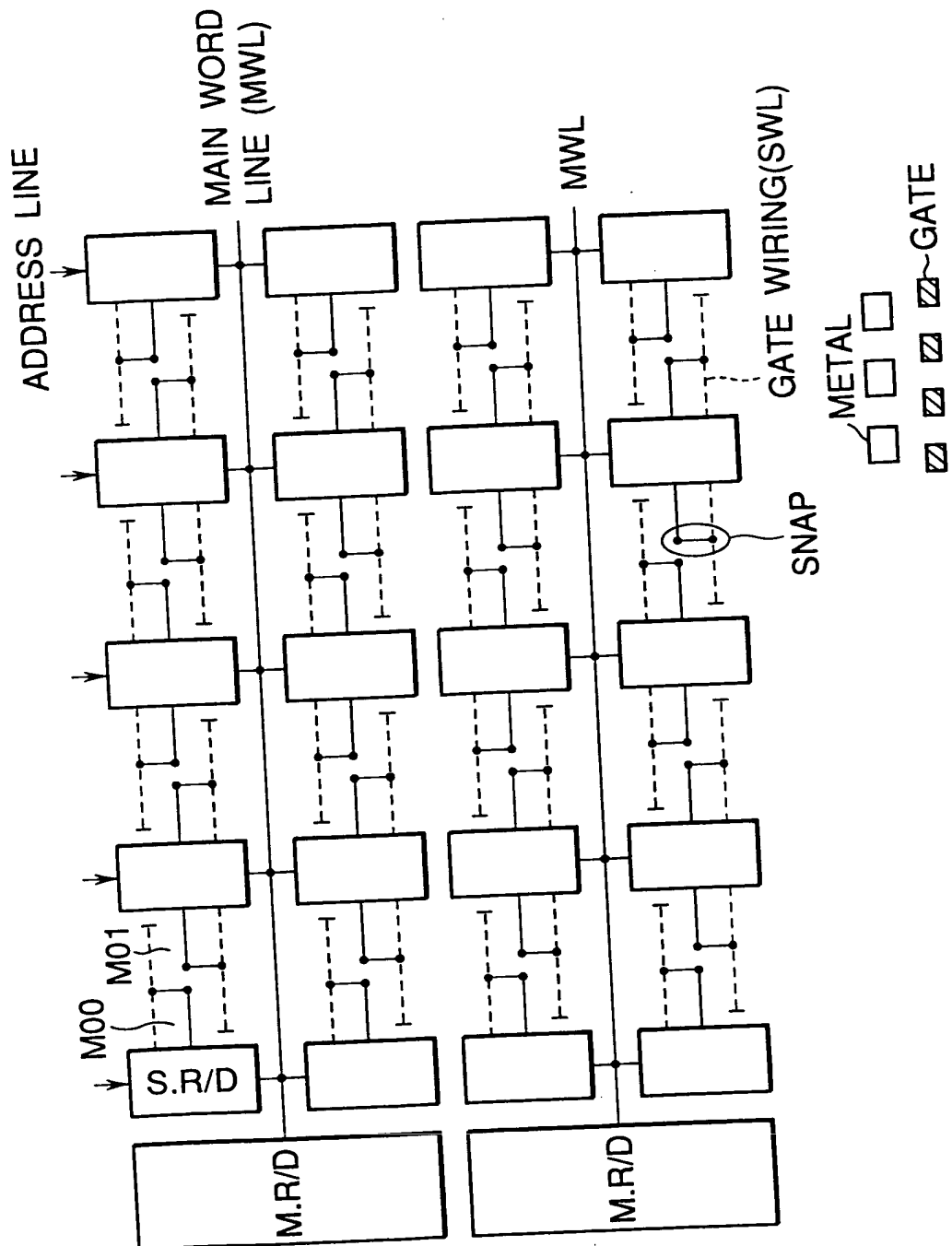


FIG. 146

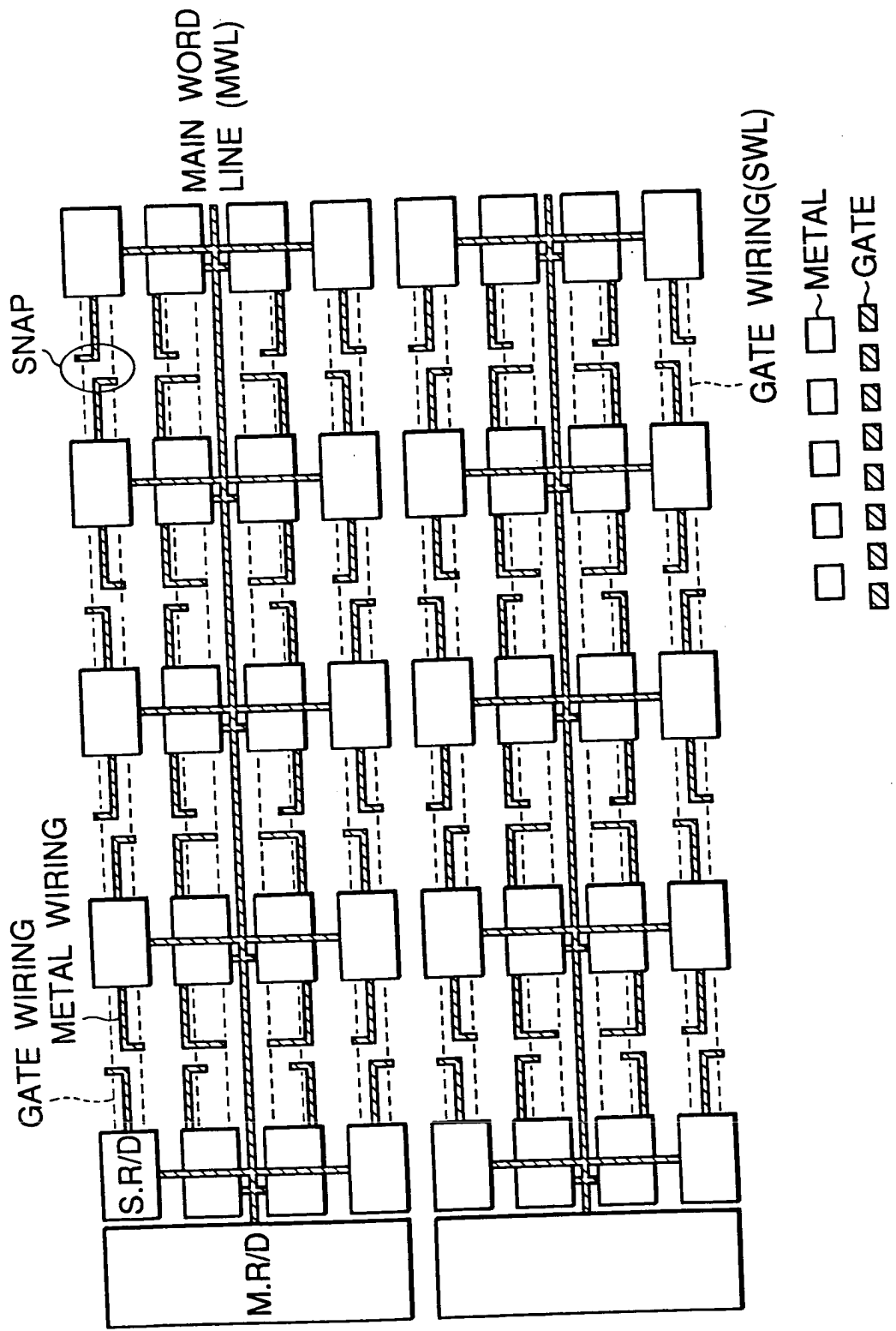


FIG.147

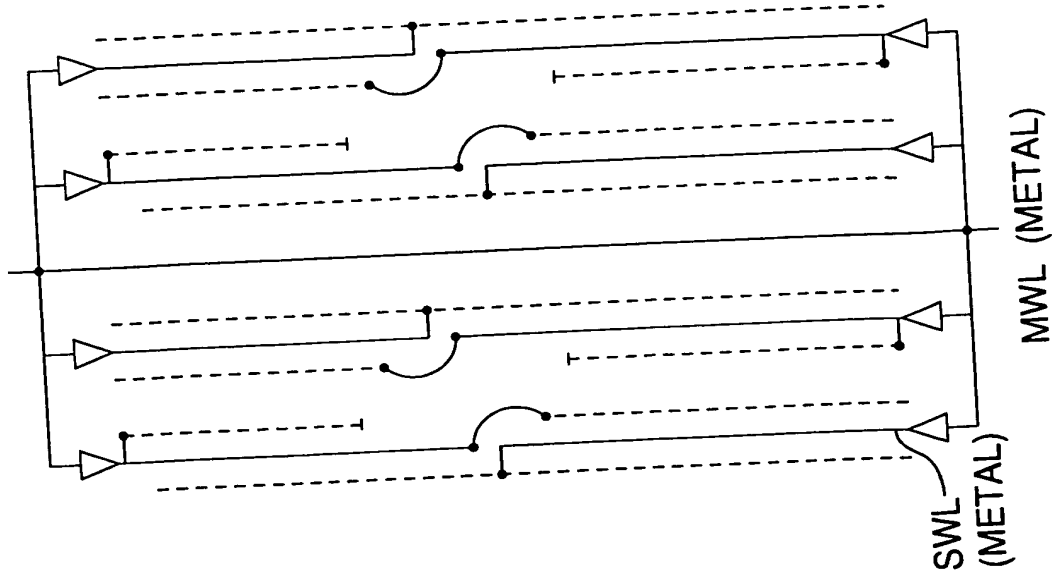


FIG. 148B

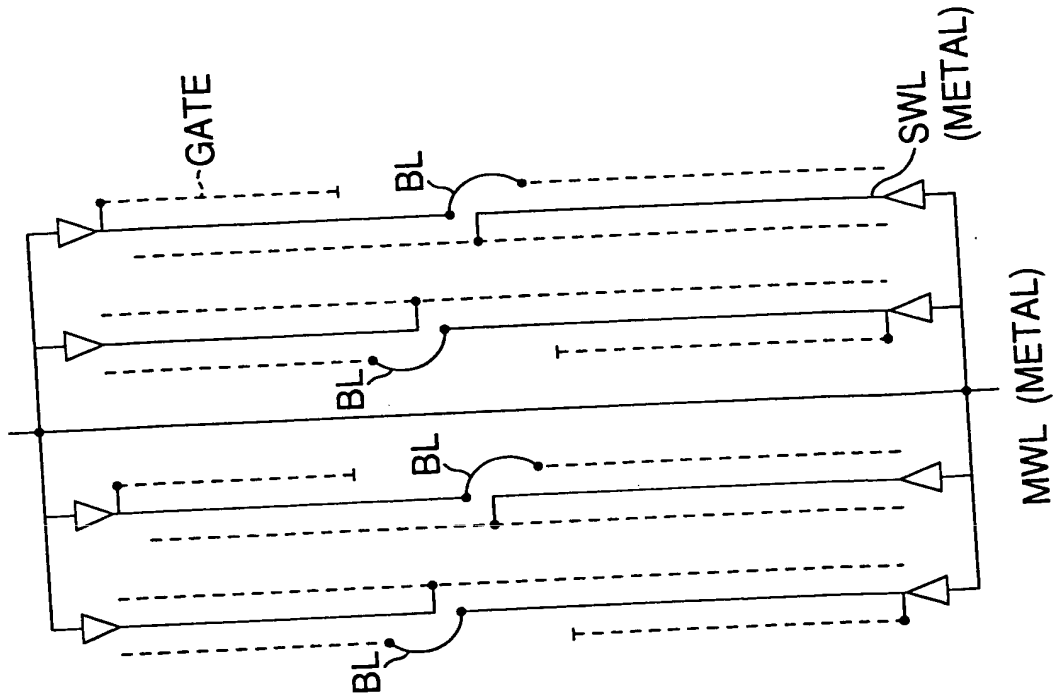


FIG. 148A

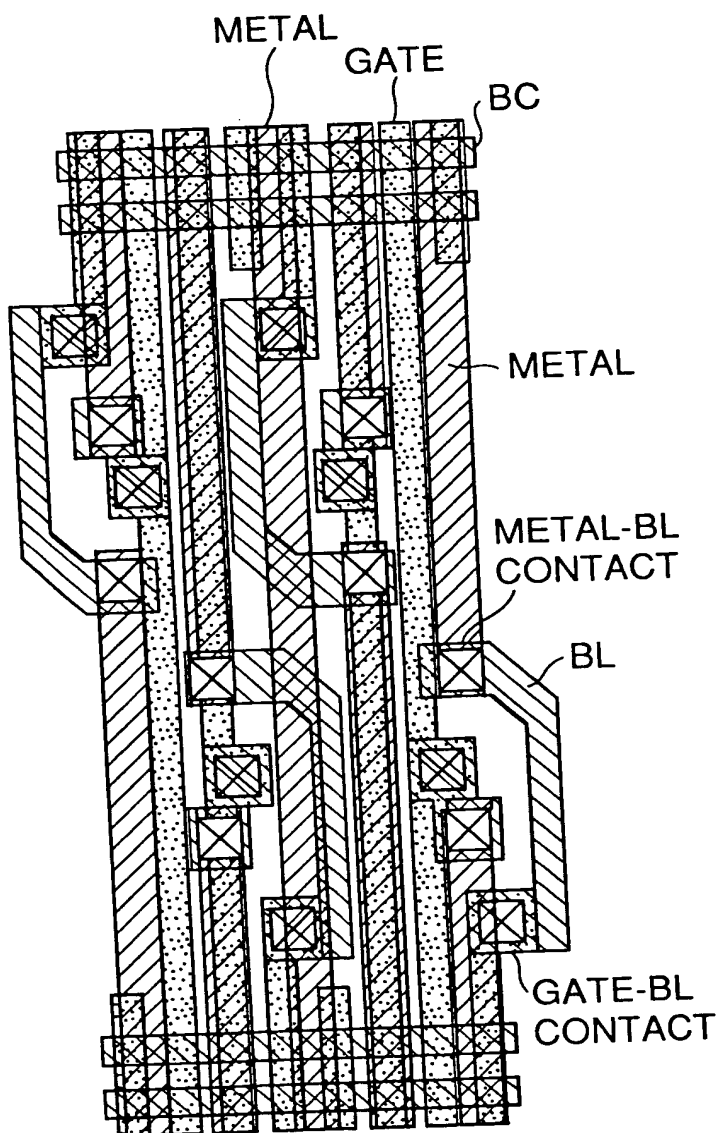


FIG. 149A

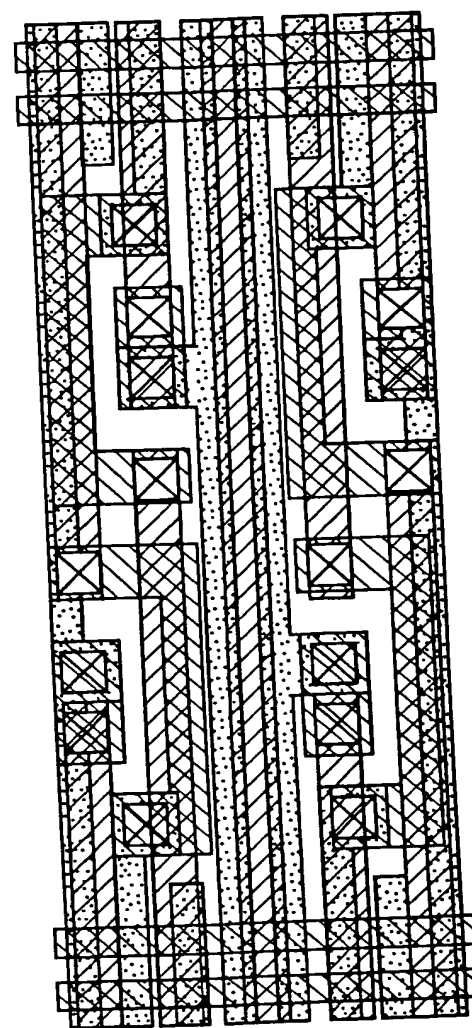


FIG. 149B

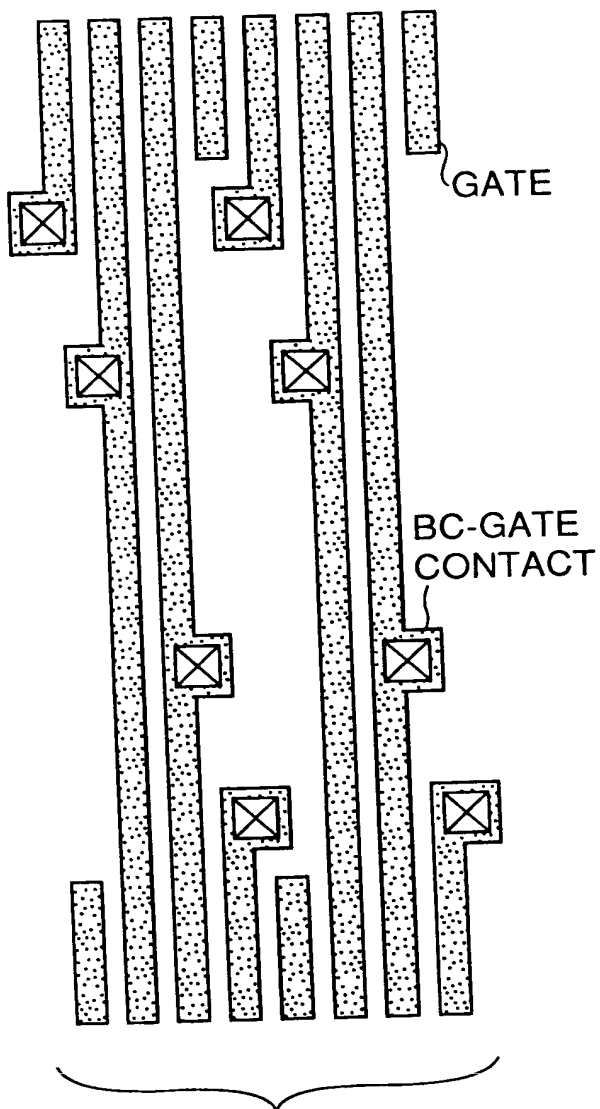
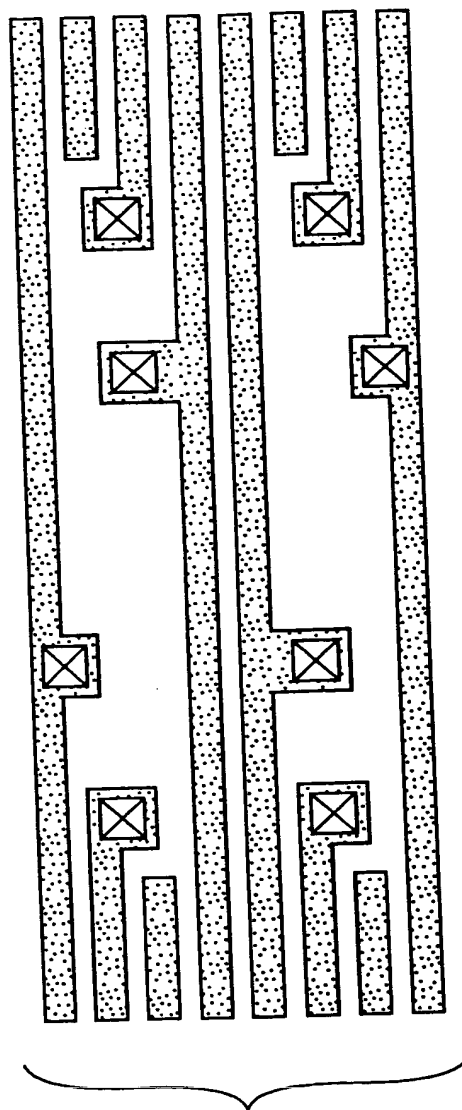


FIG. 150A



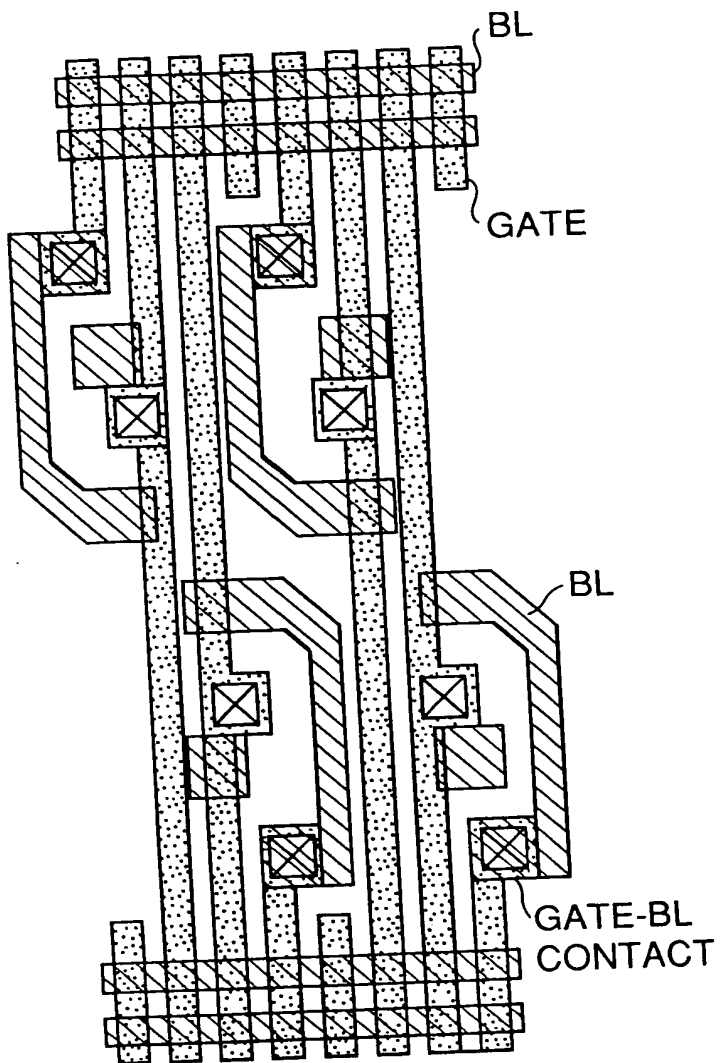


FIG. 151A

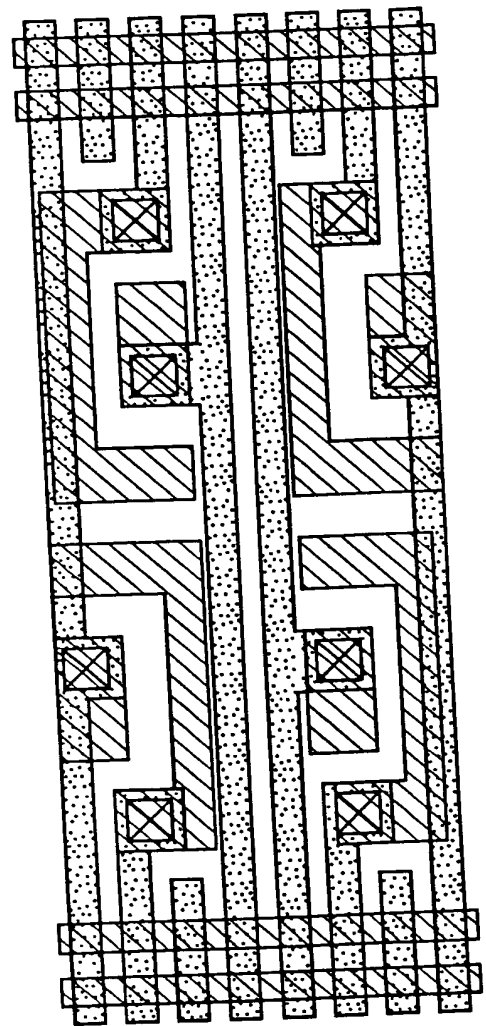


FIG. 151B

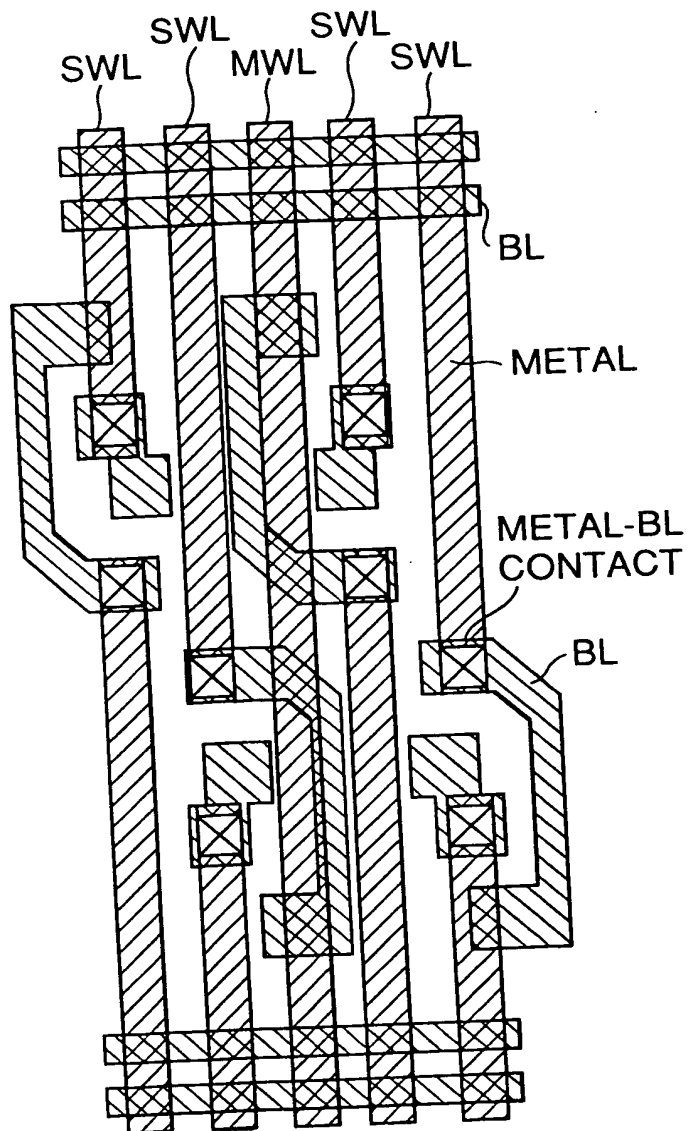


FIG. 152A

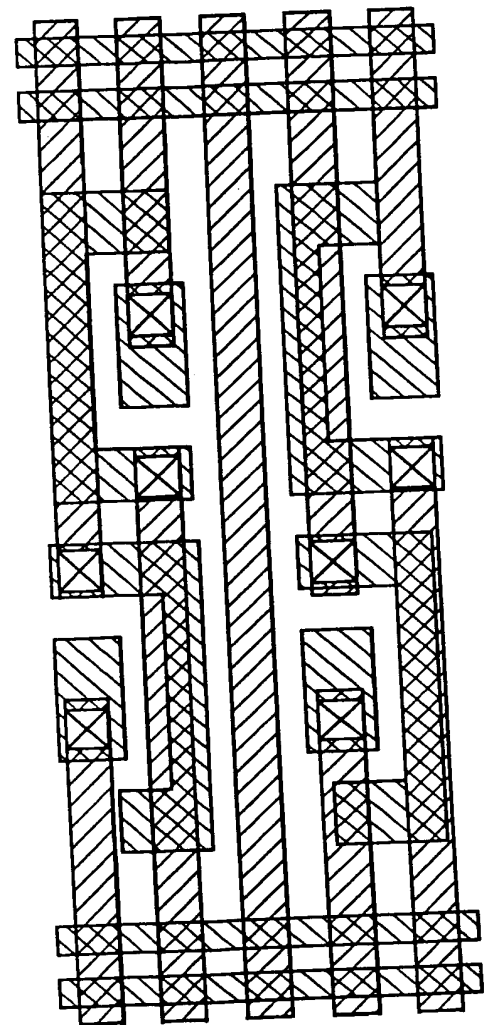


FIG. 152B

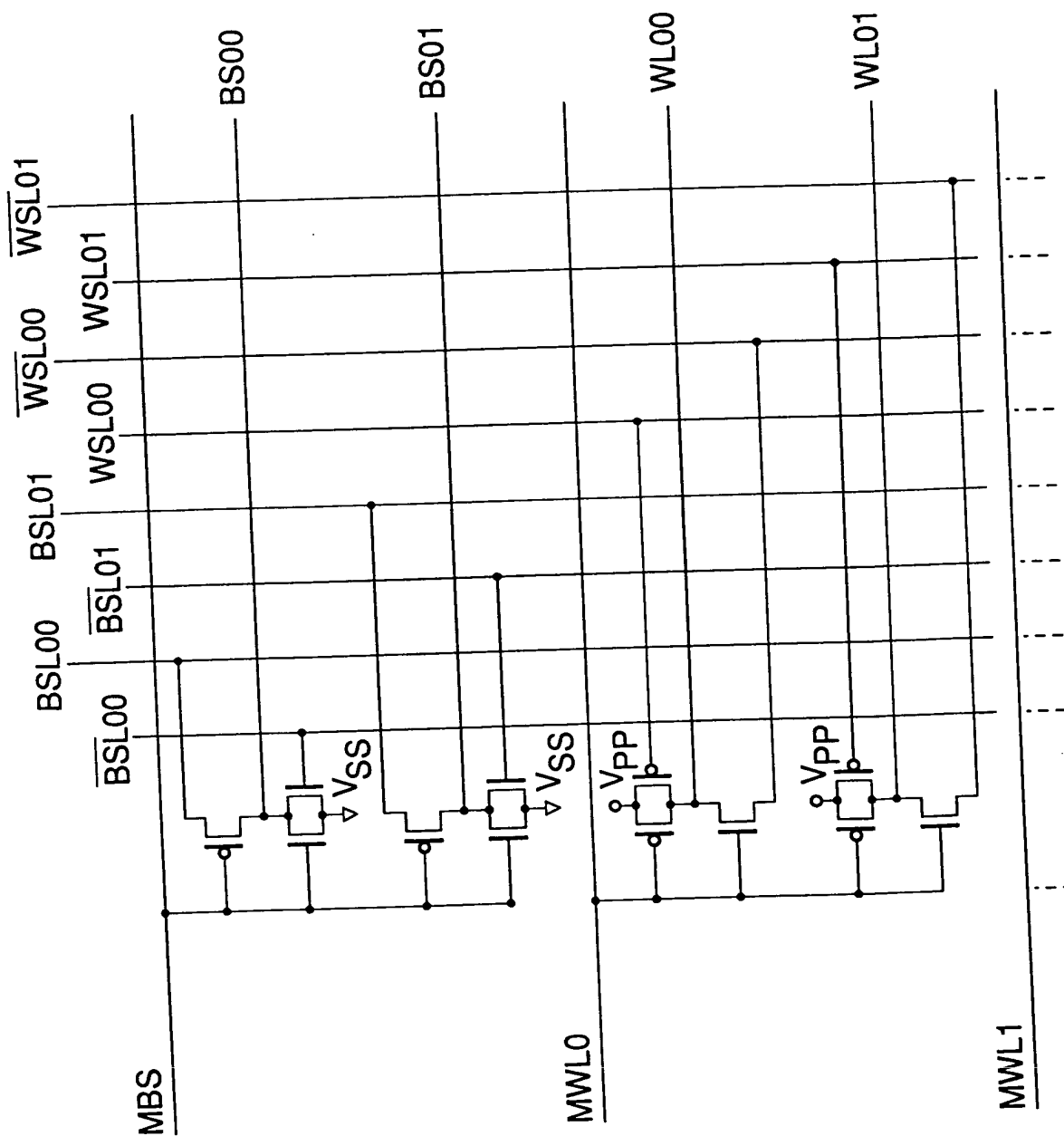


FIG. 153

FIG. 154

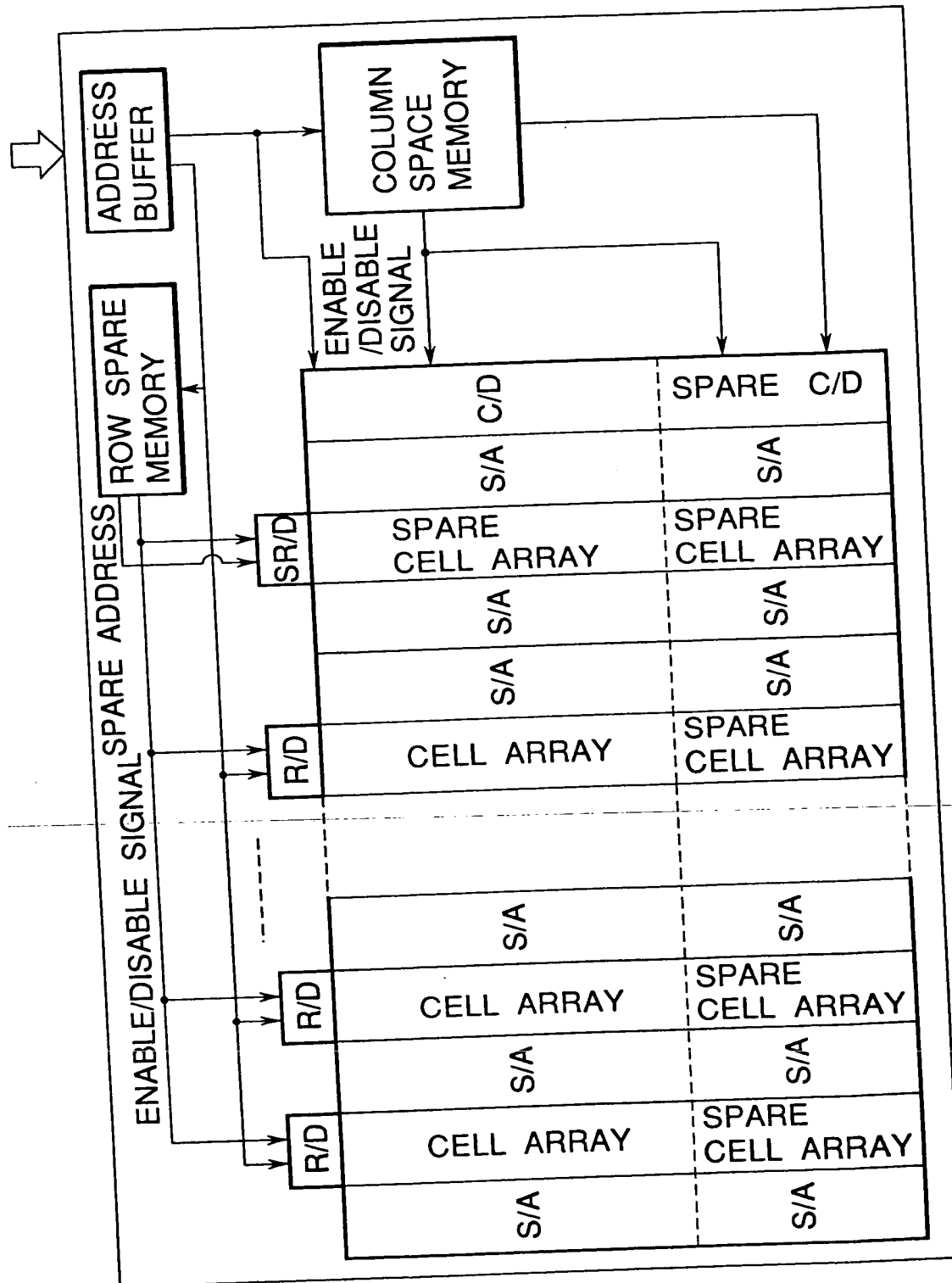


FIG. 155

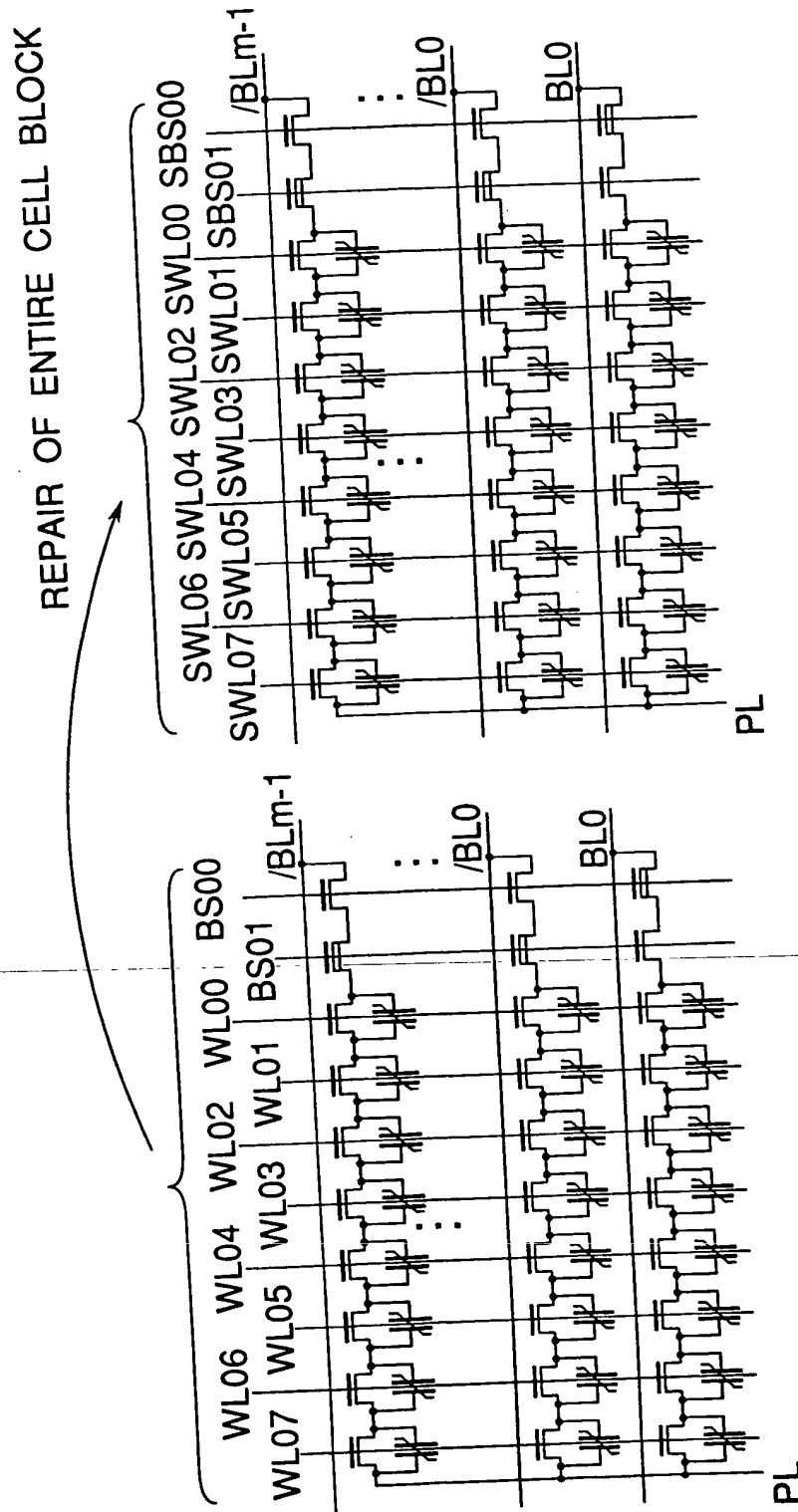


FIG. 156



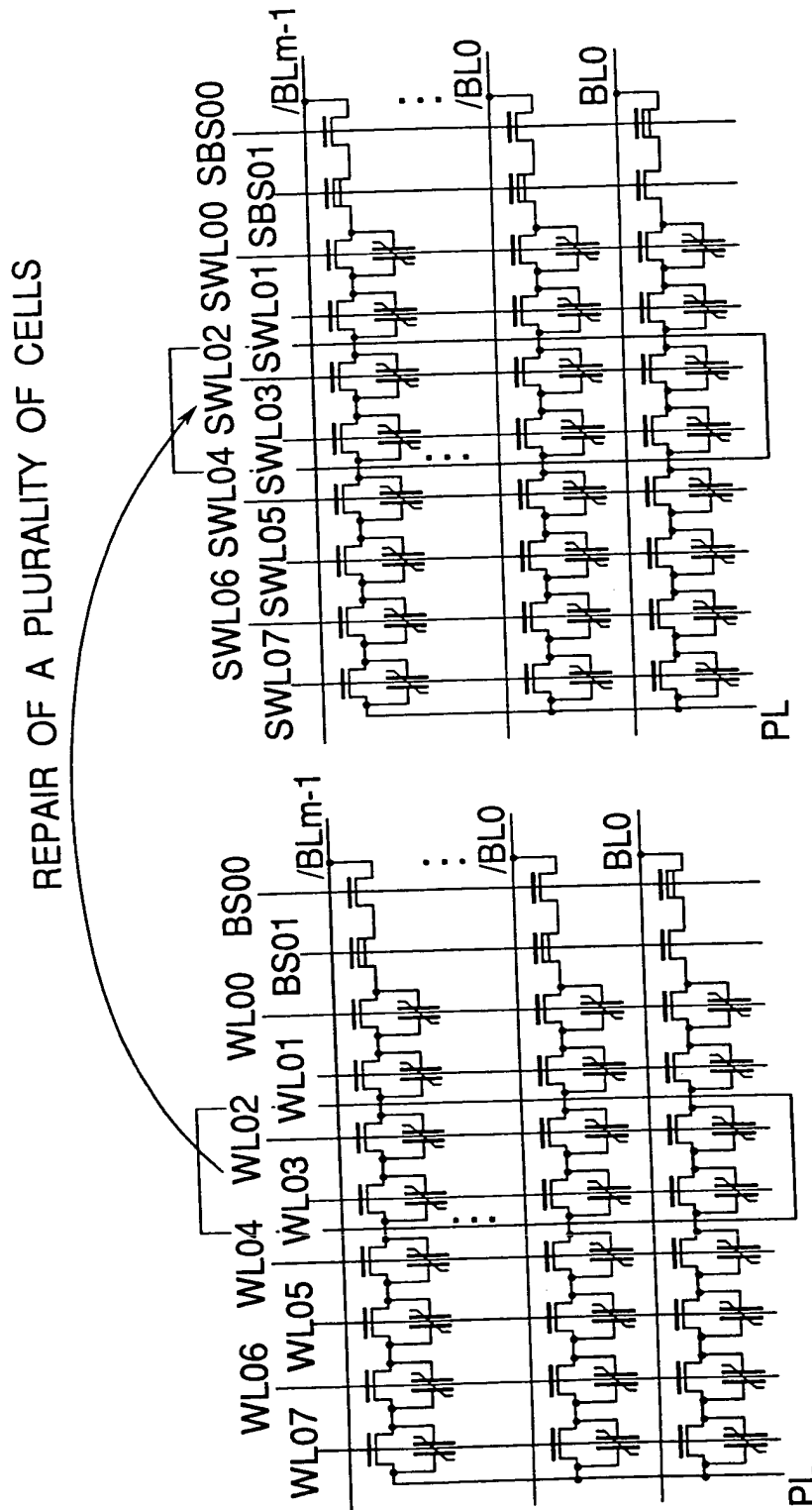


FIG. 158

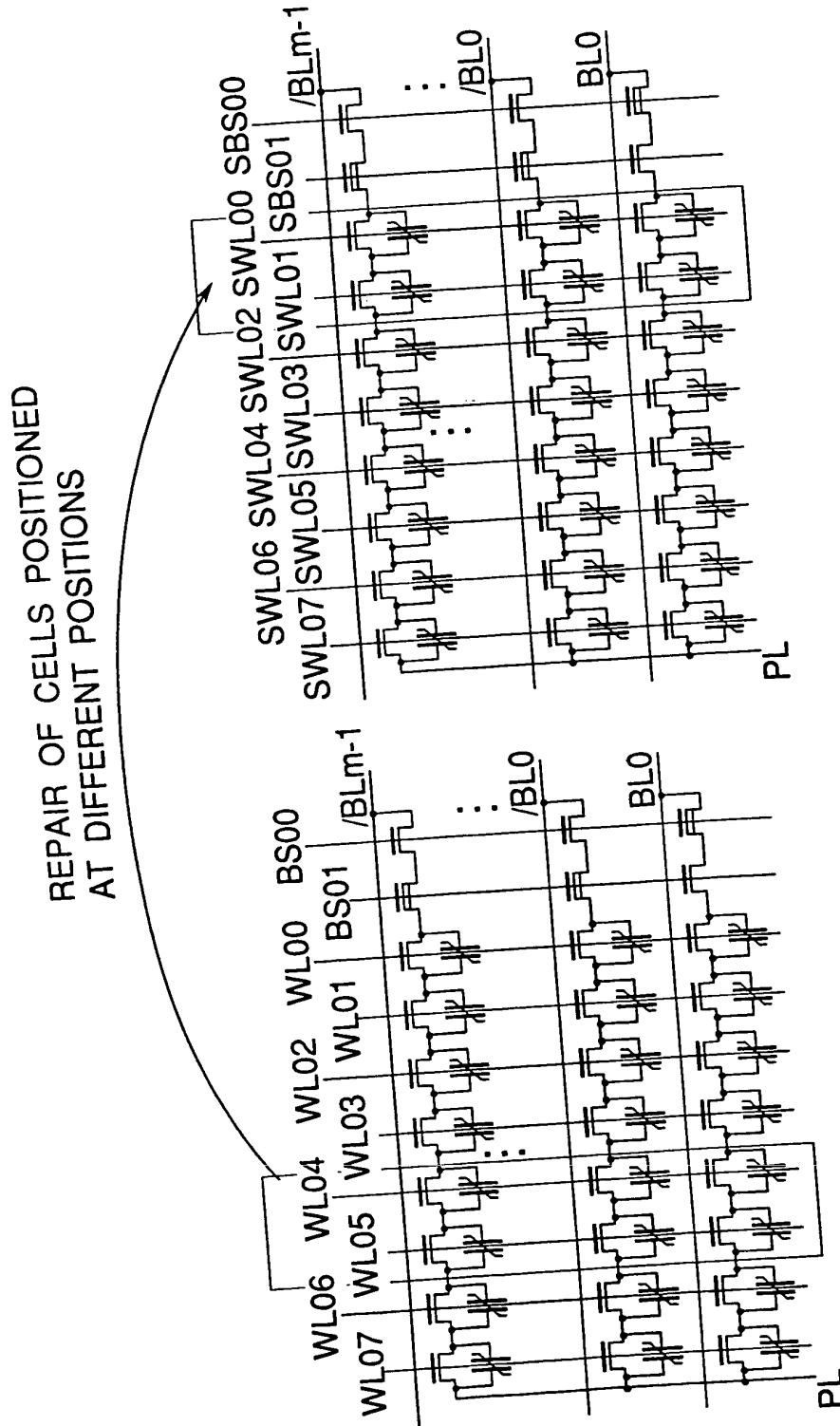


FIG. 159

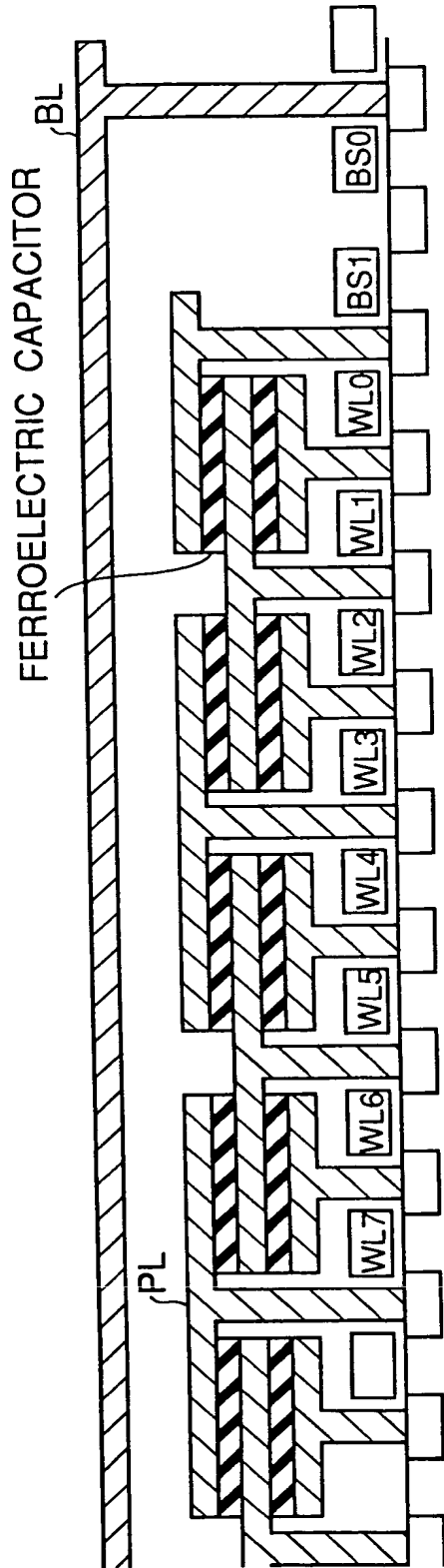


FIG. 160

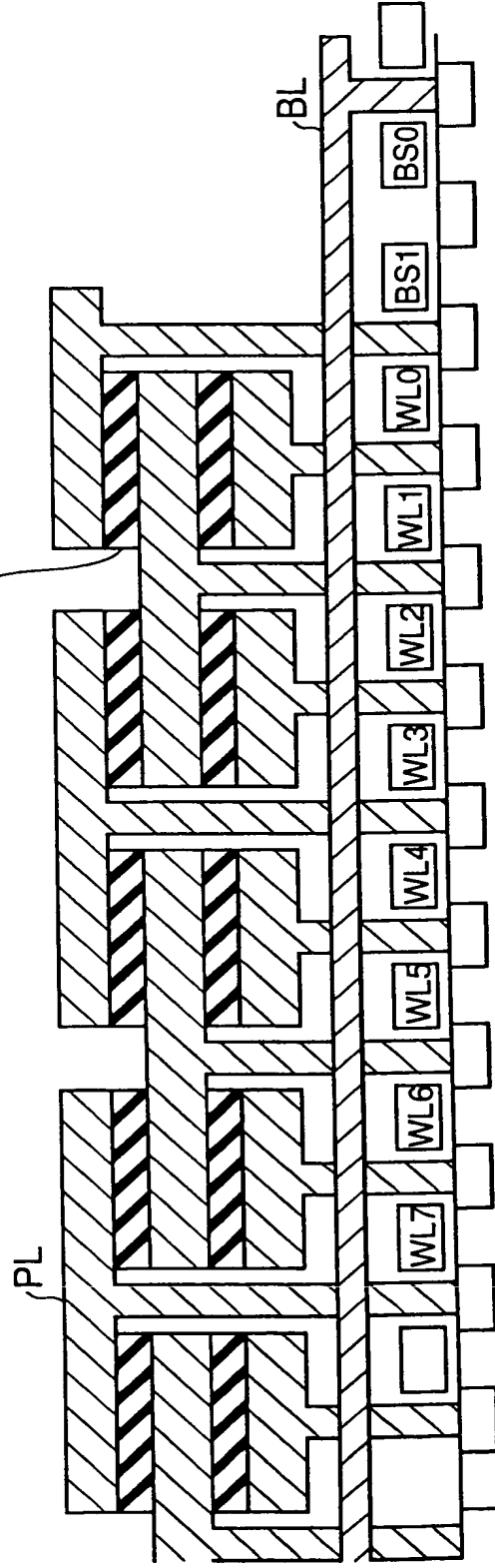


FIG. 161

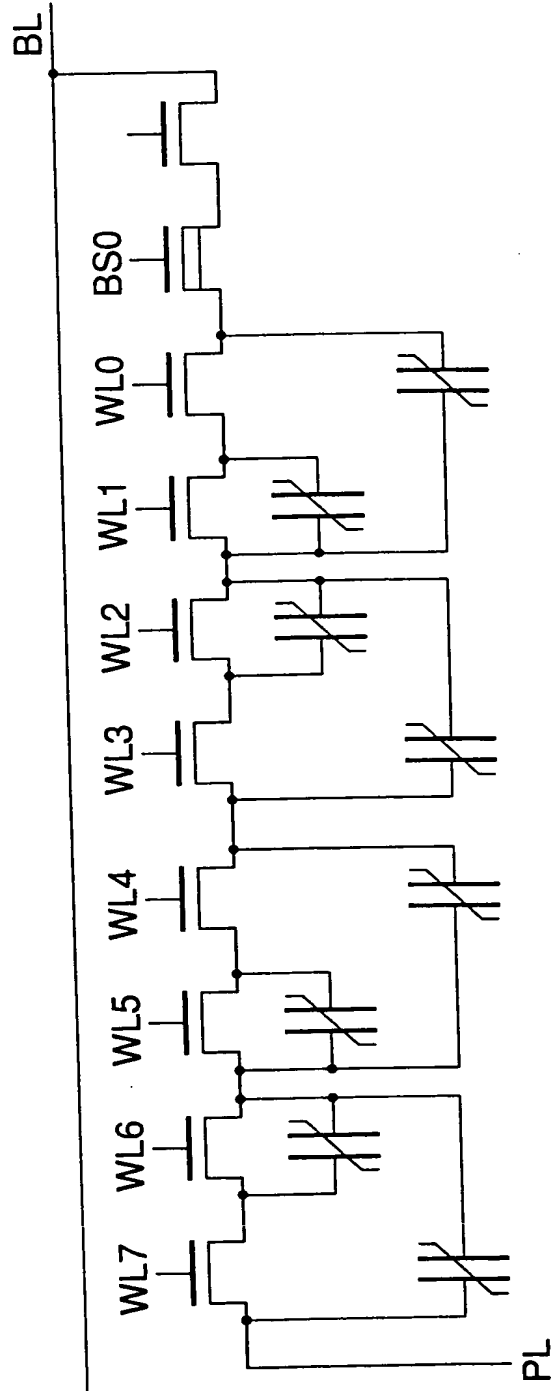


FIG. 162

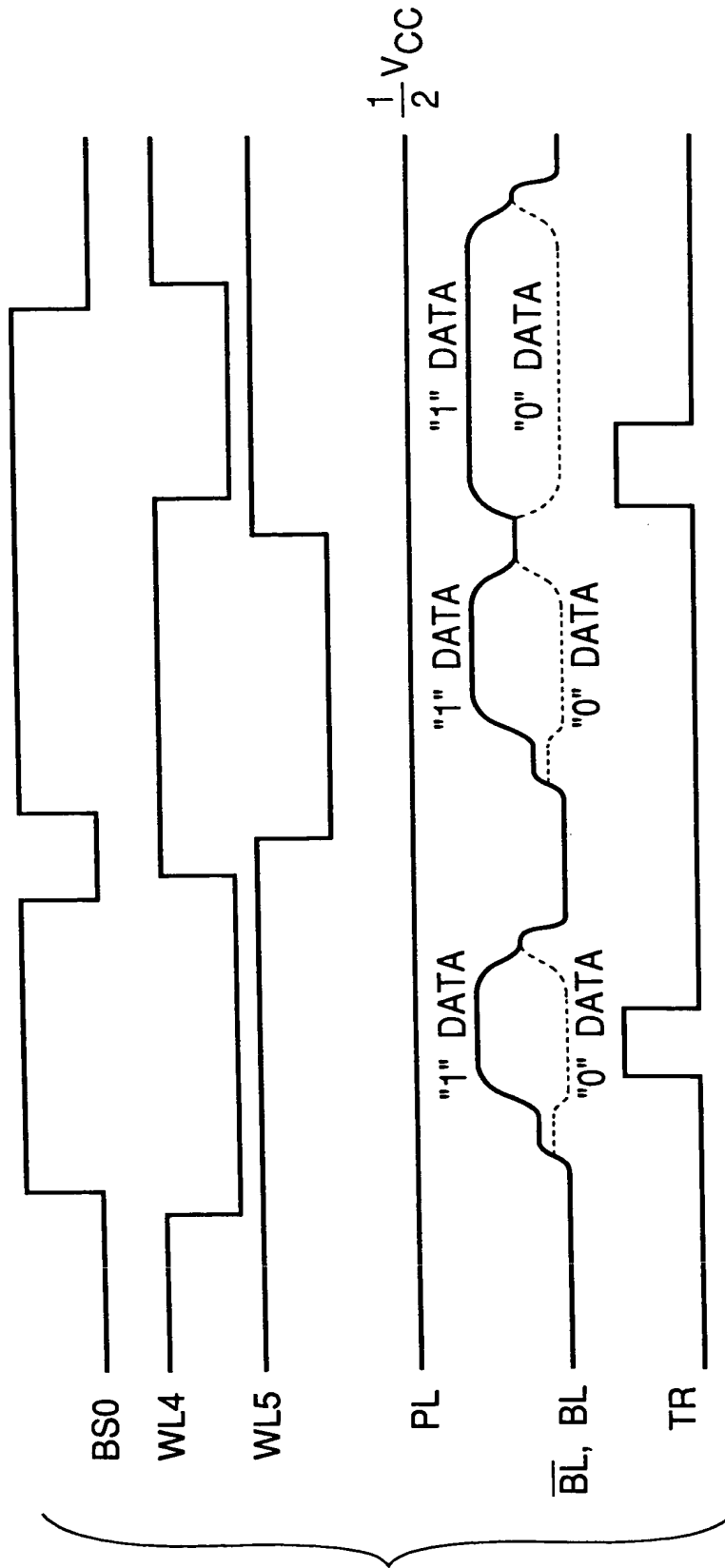


FIG. 163

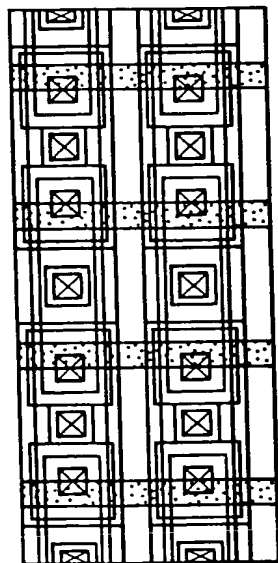


FIG. 164C

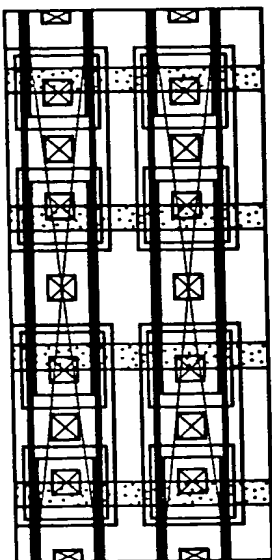


FIG. 164D

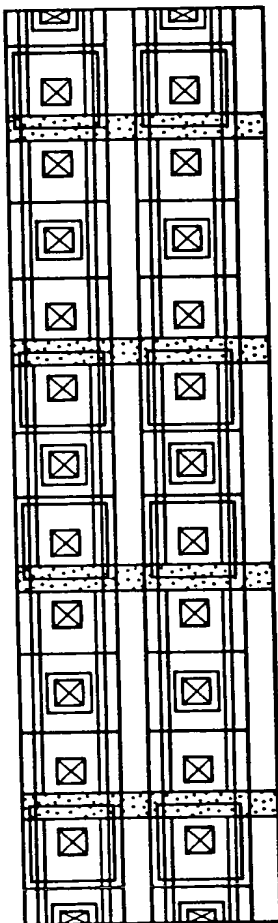


FIG. 164B

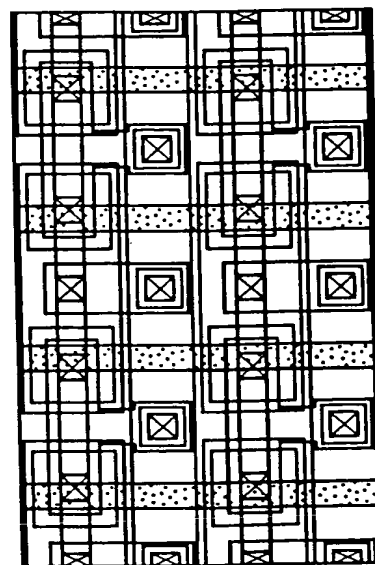


FIG. 164A

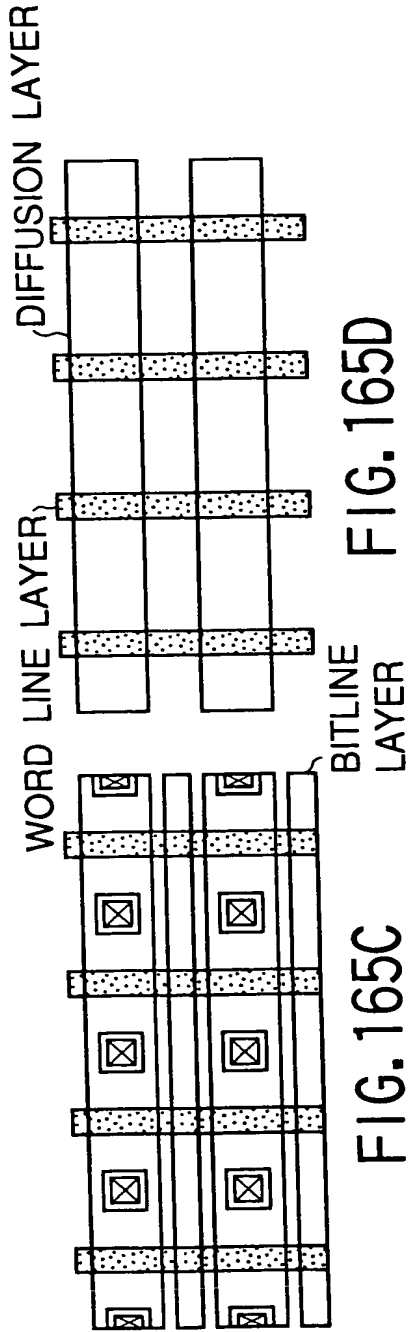


FIG. 165D

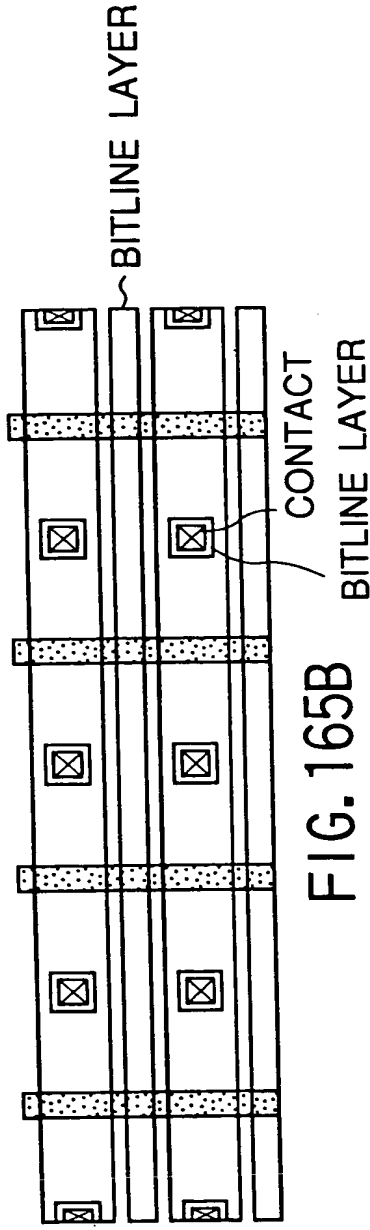


FIG. 165B

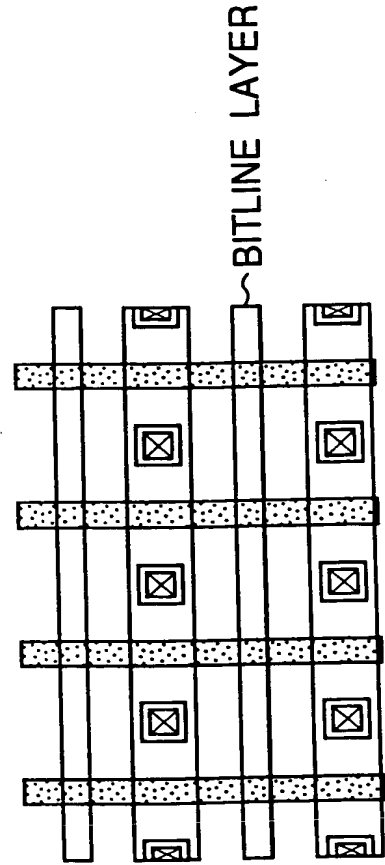
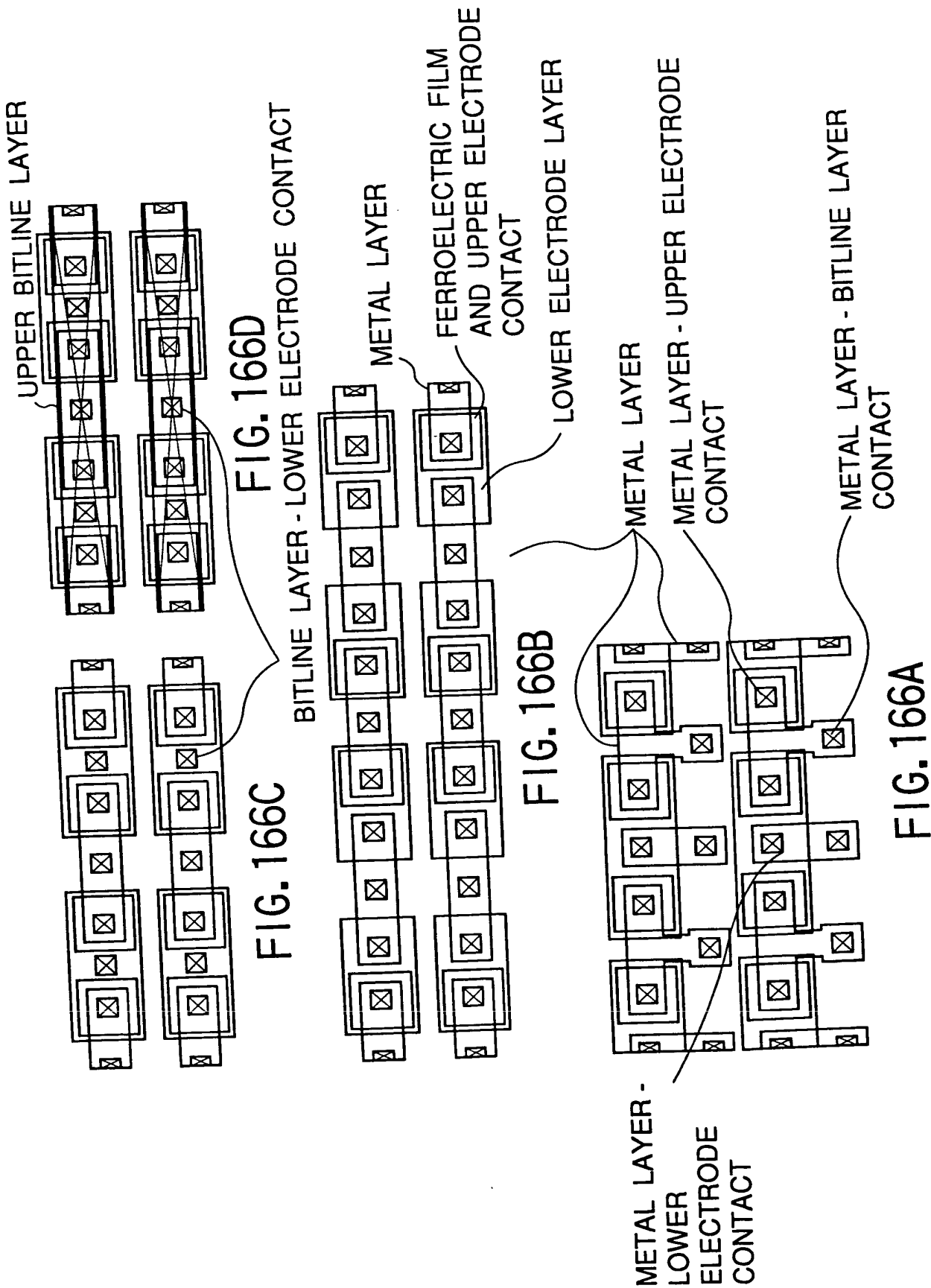
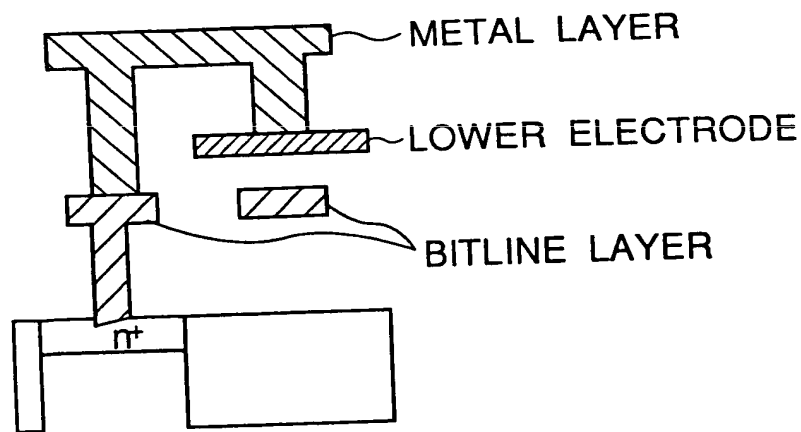
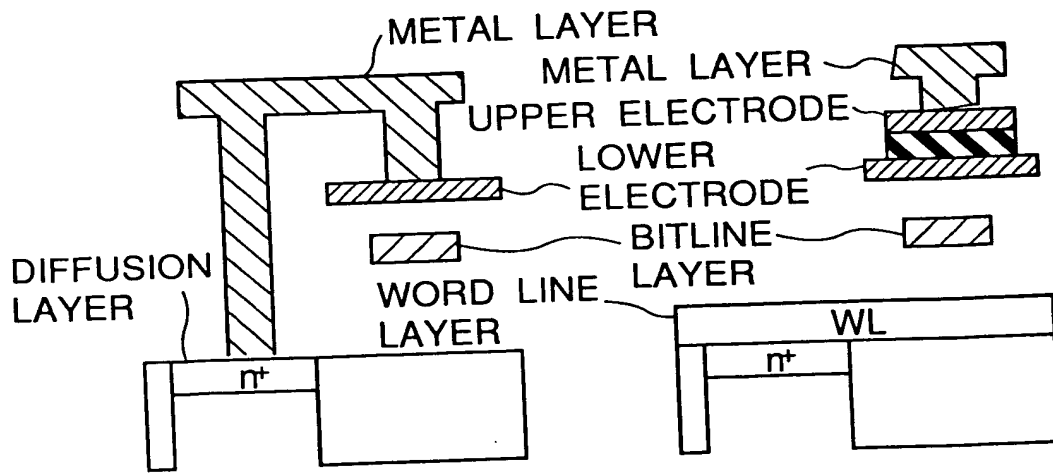
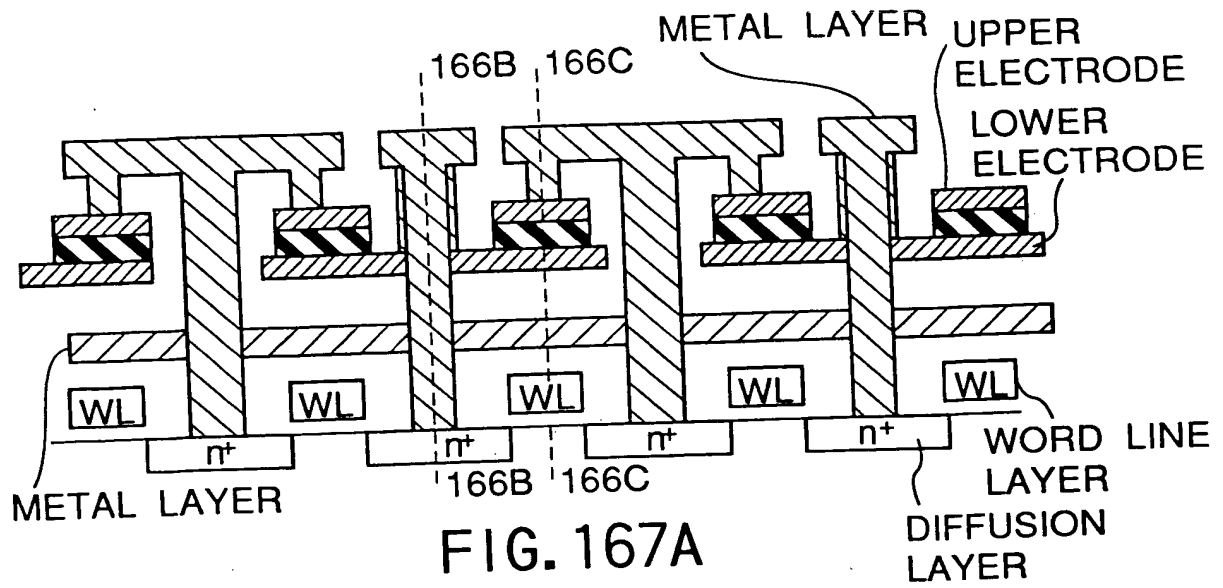


FIG. 165A





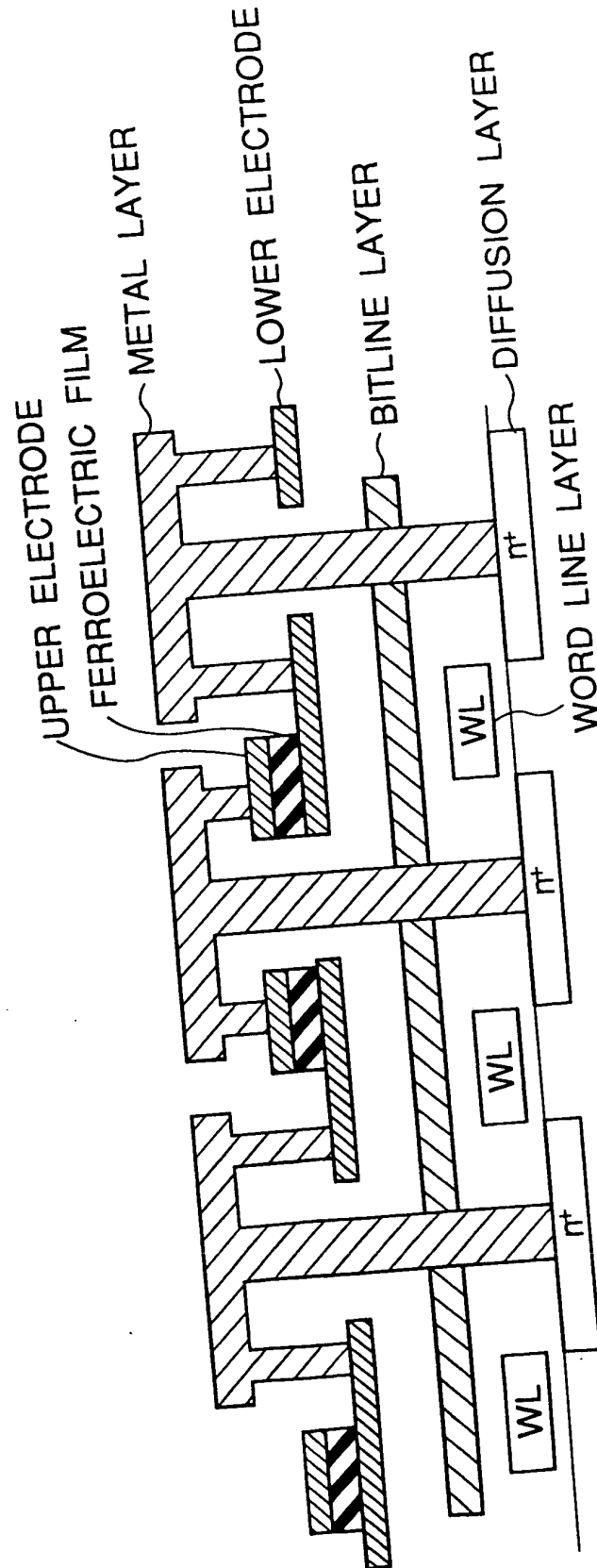


FIG. 168

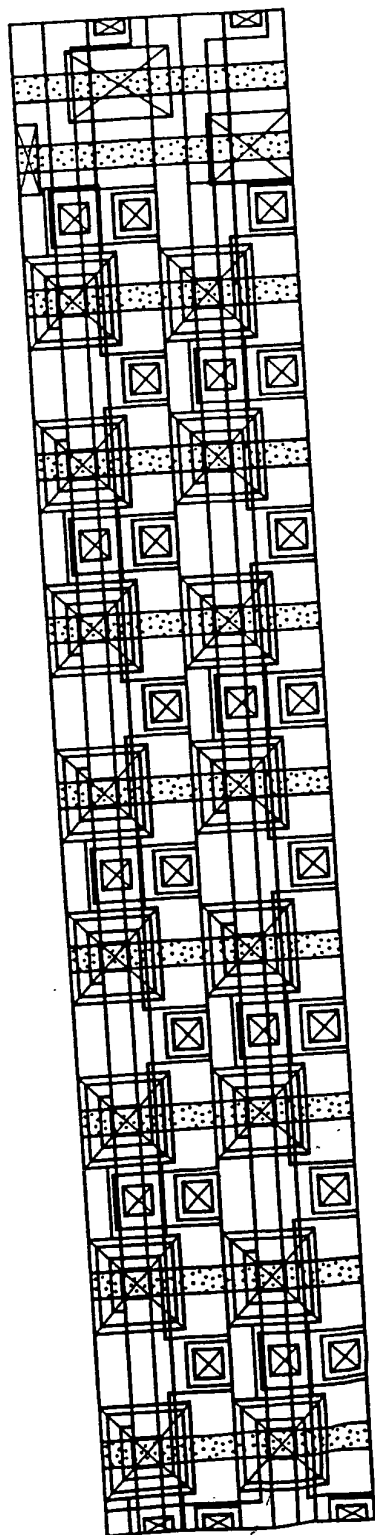


FIG. 169A

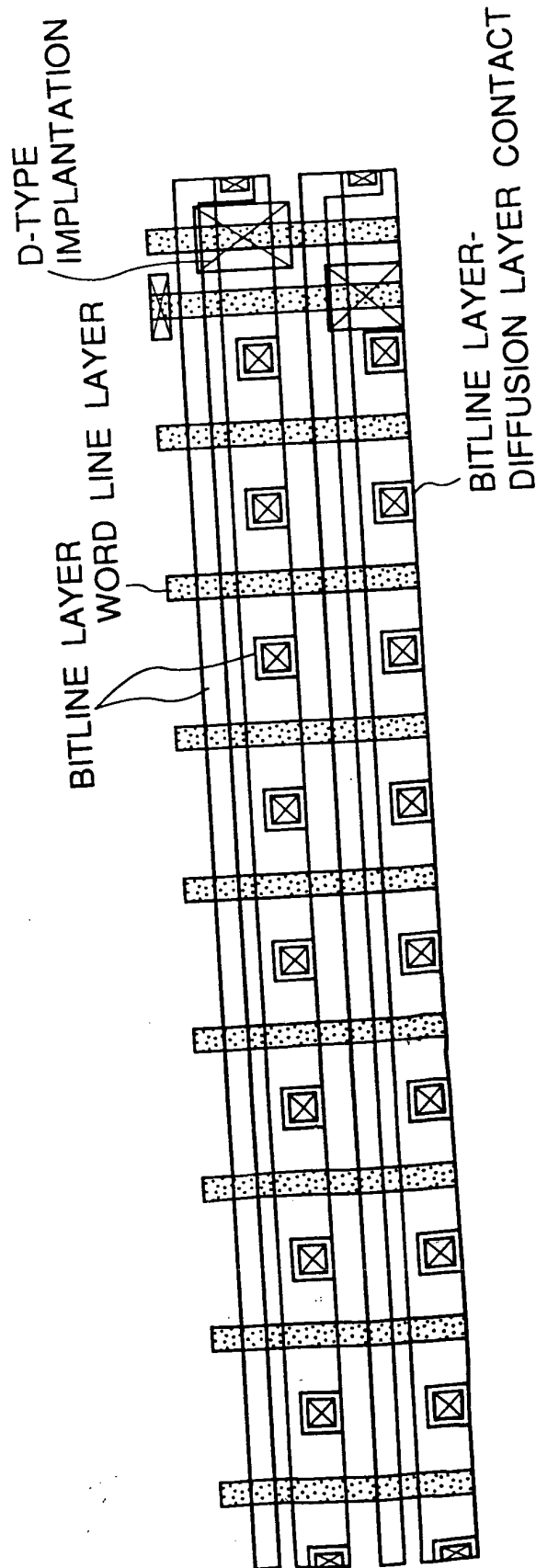


FIG. 169B

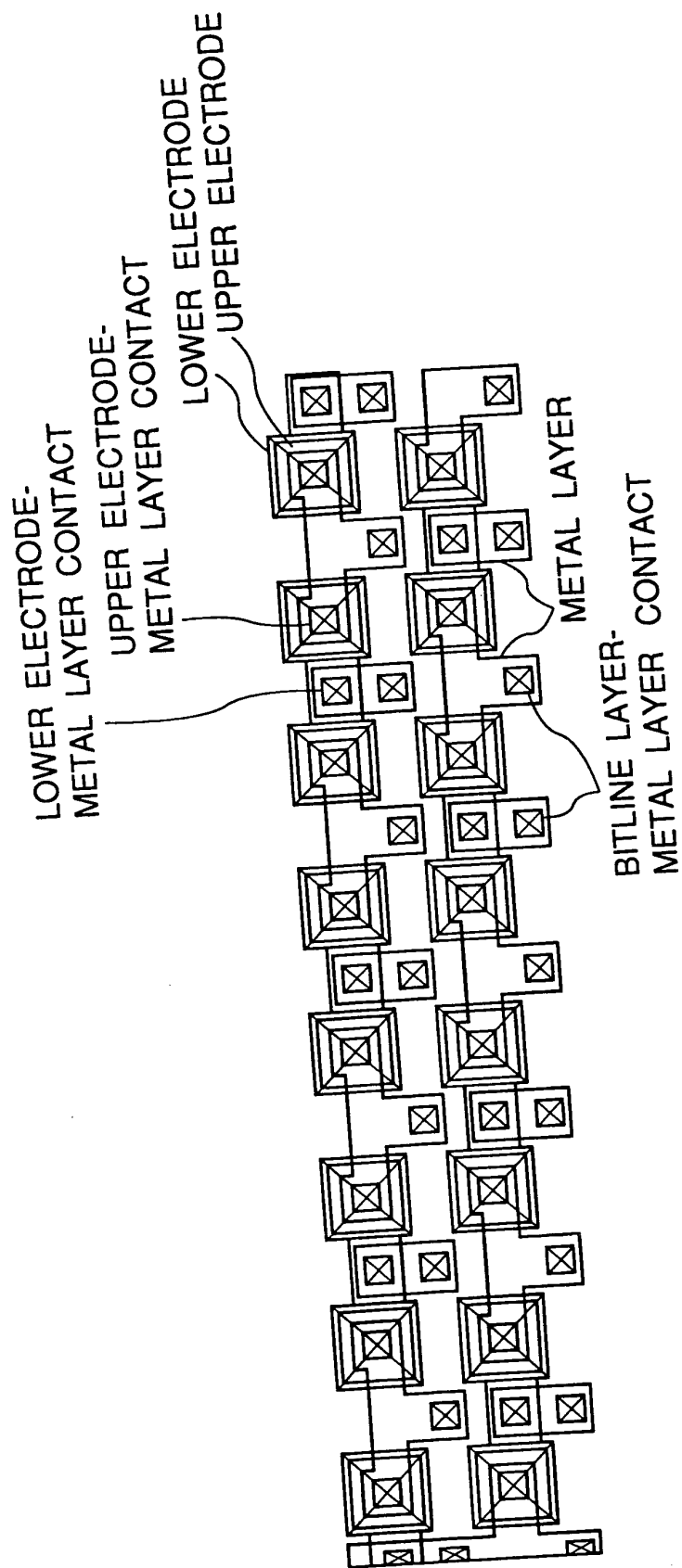


FIG. 169C

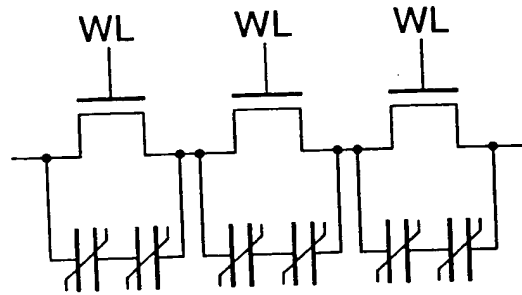


FIG. 170A

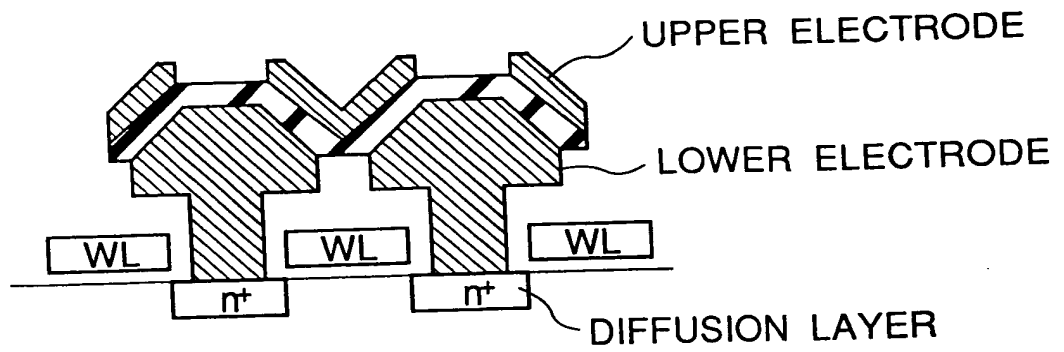
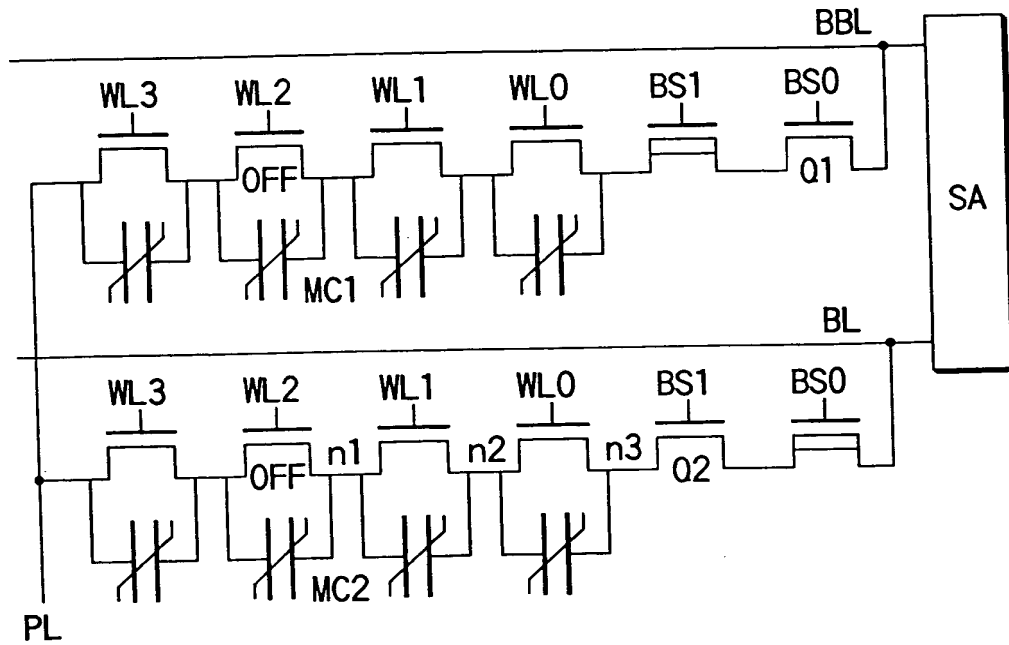


FIG. 170B



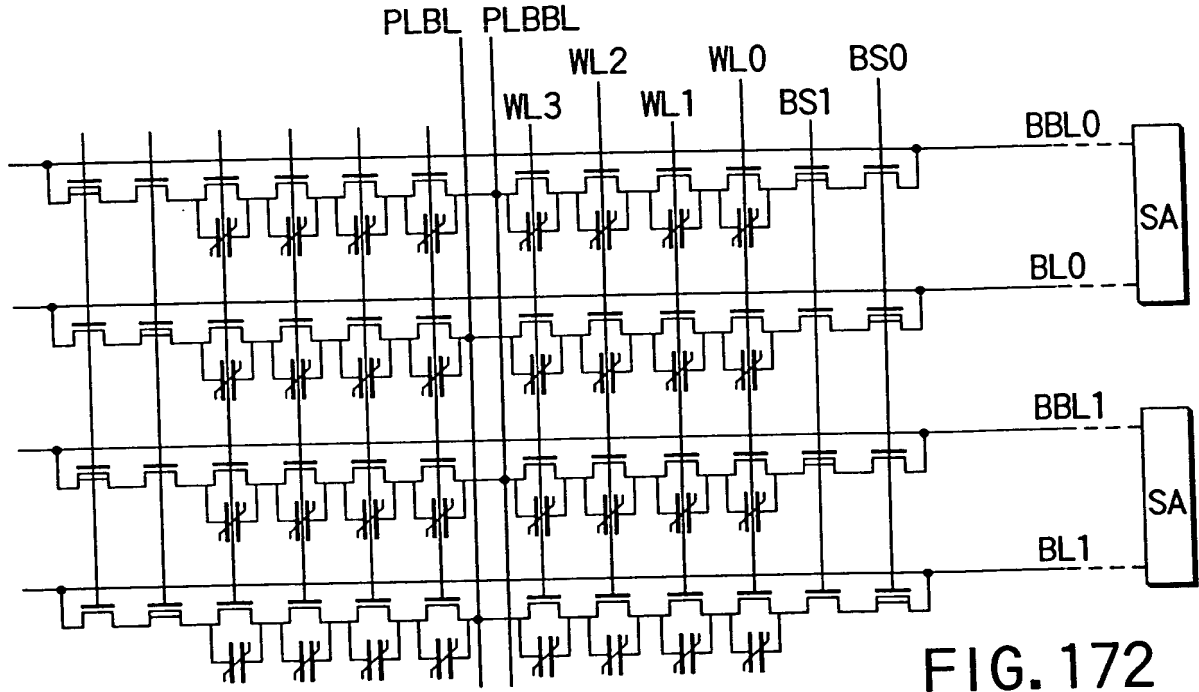


FIG. 172

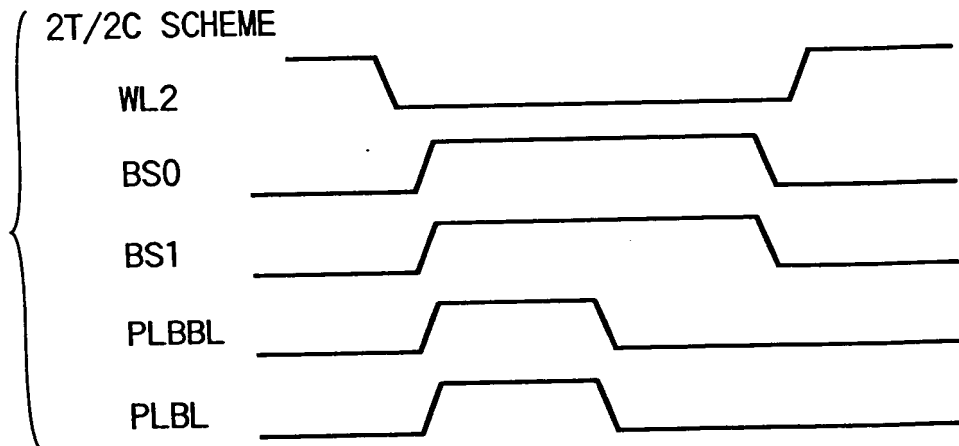


FIG. 173A

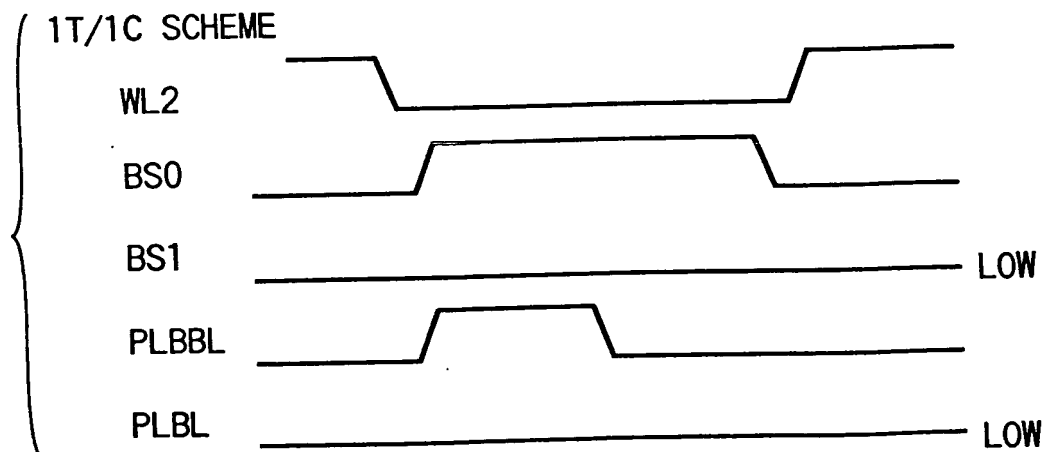


FIG. 173B

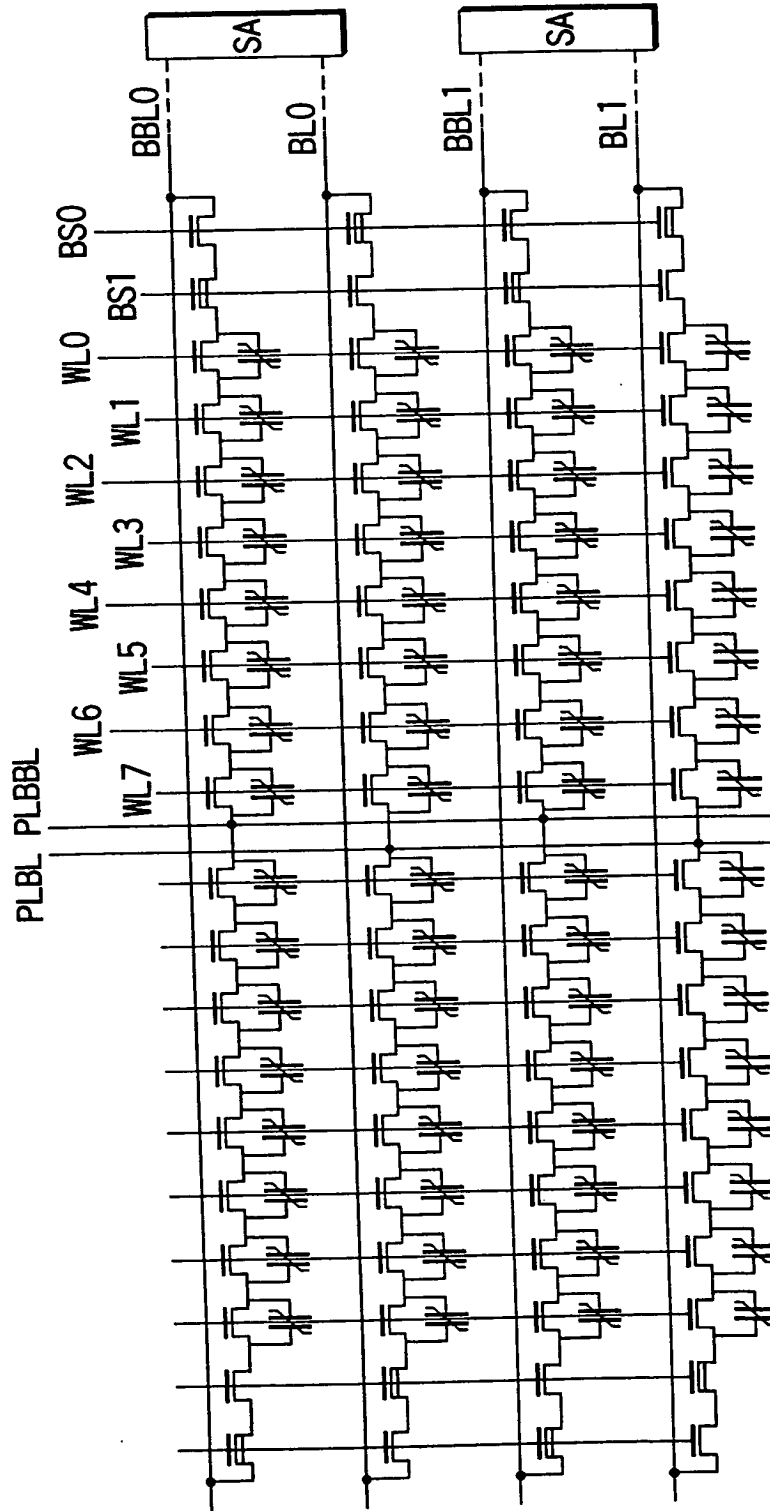


FIG.174

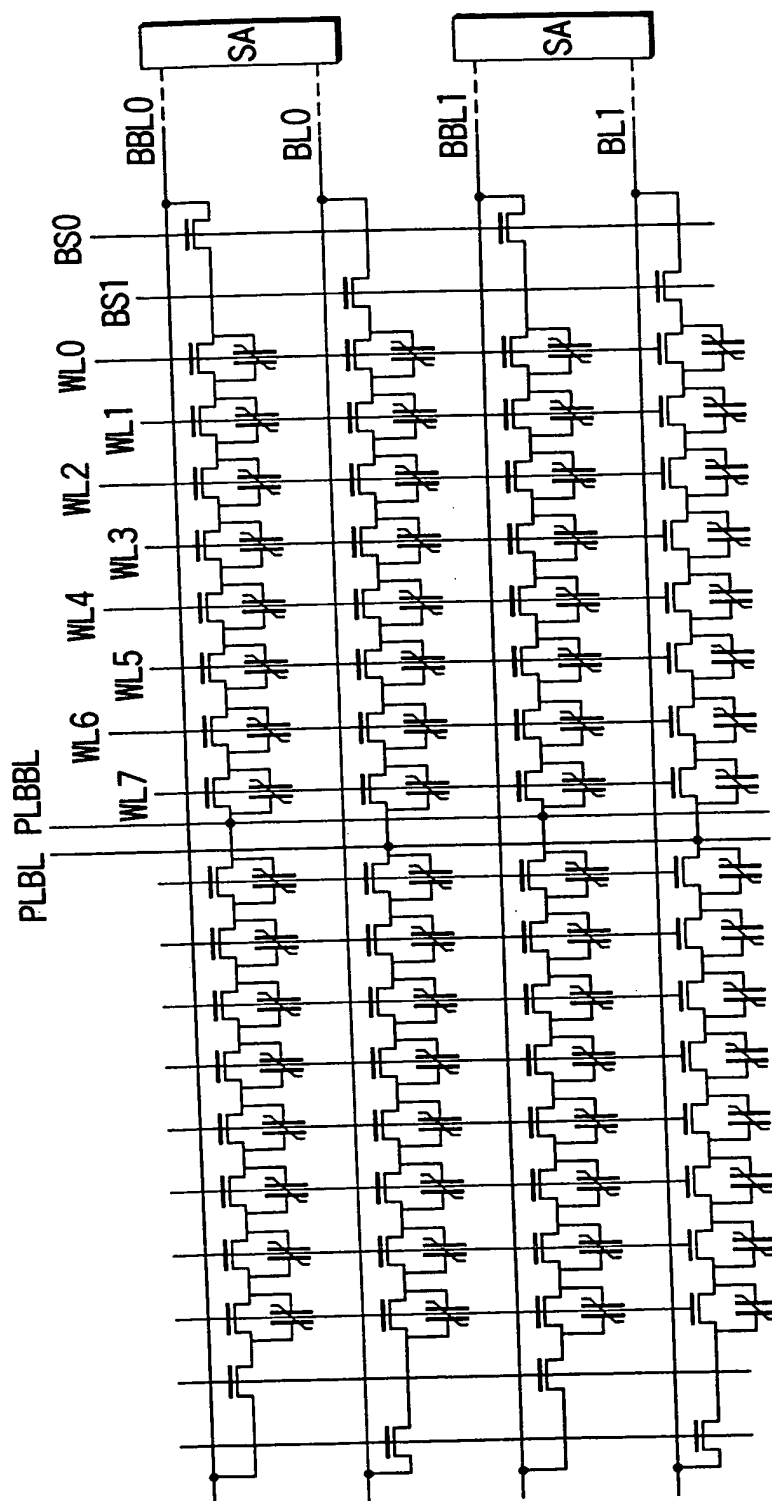


FIG.175

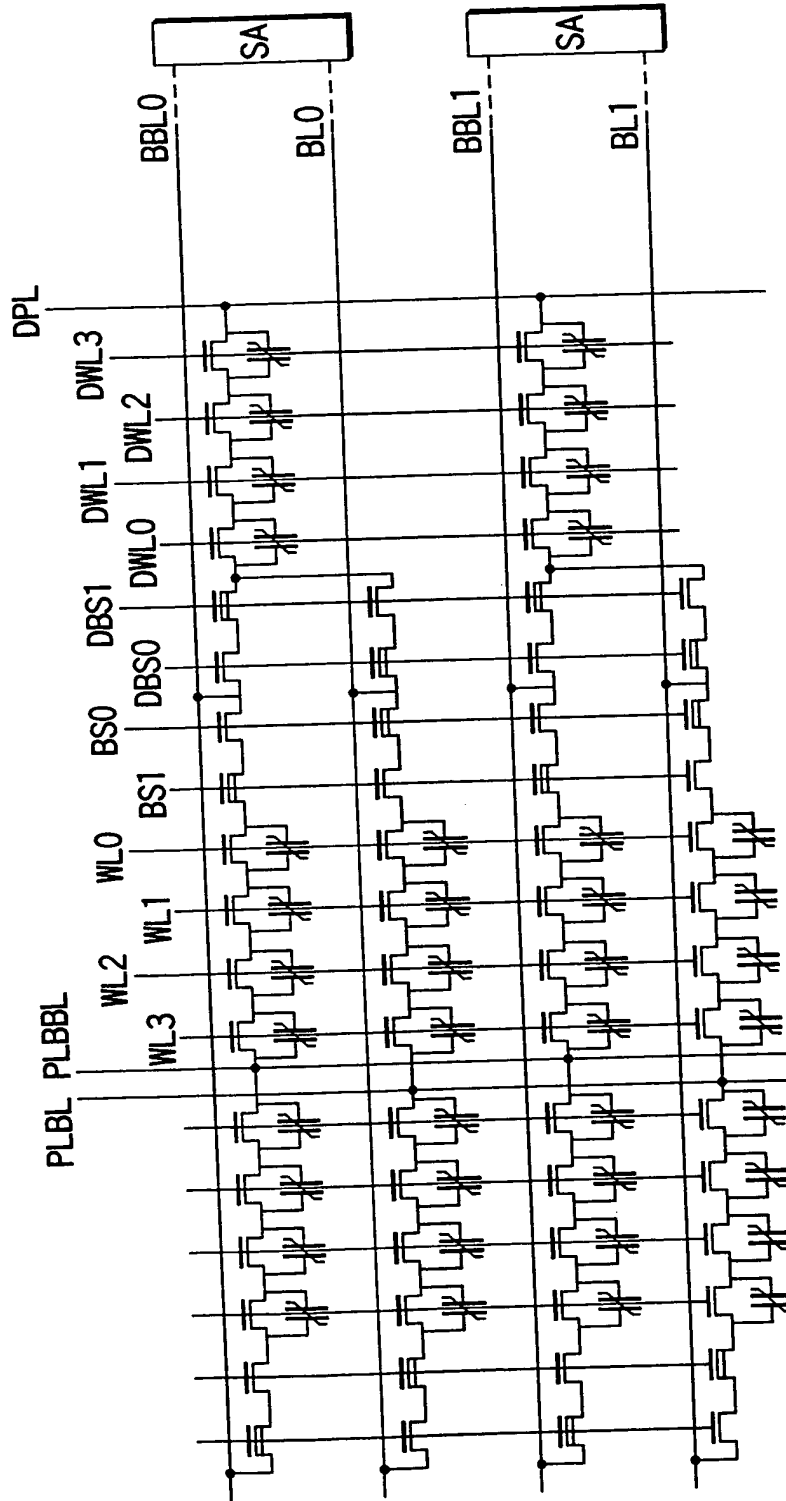


FIG. 176

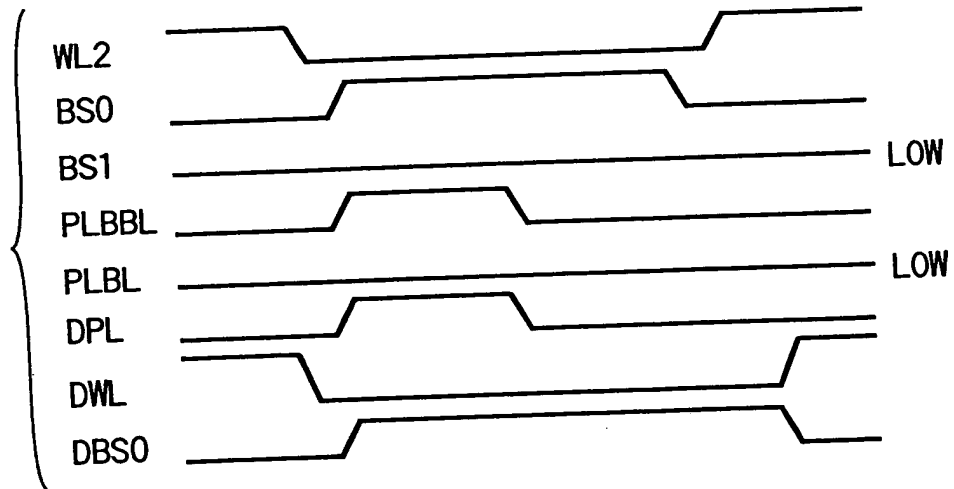


FIG. 177A

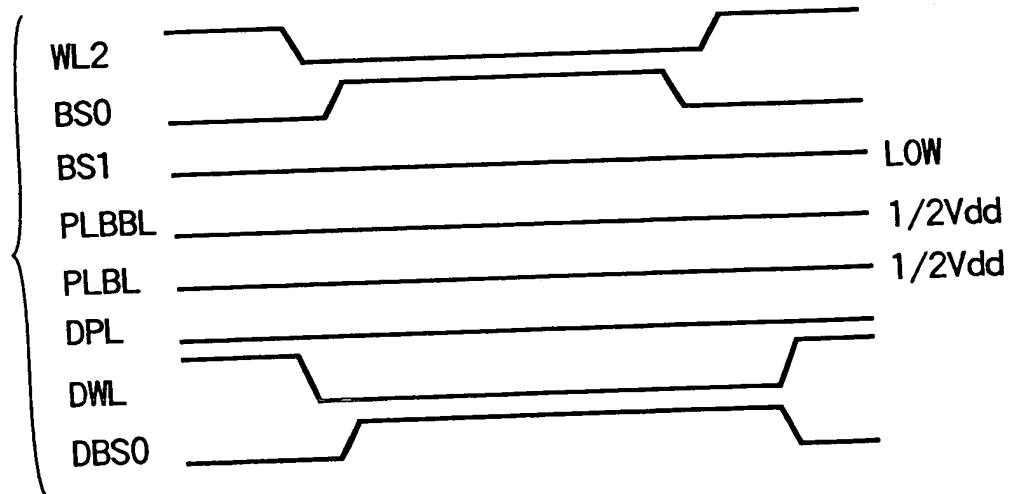


FIG. 177B

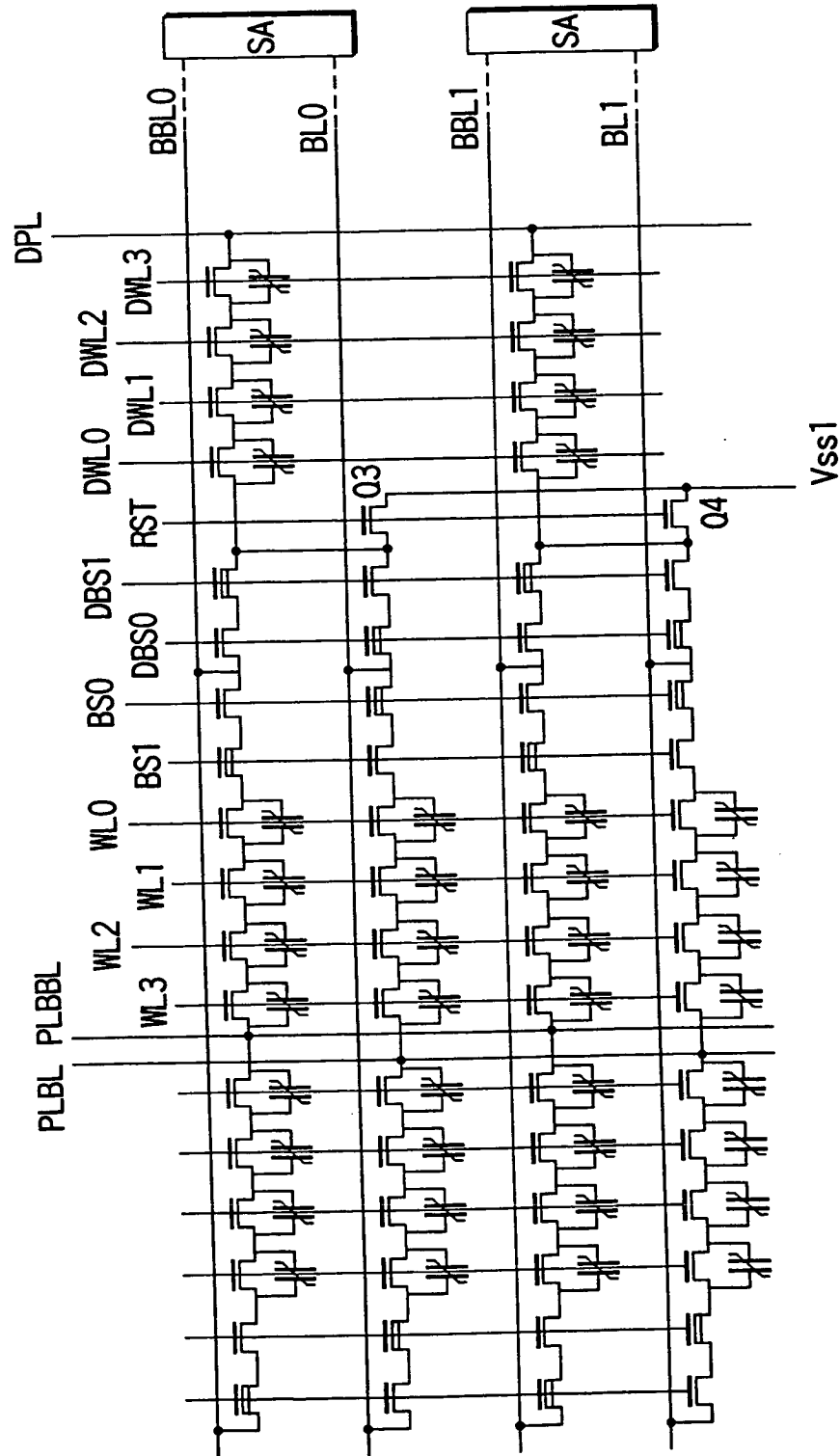


FIG.178

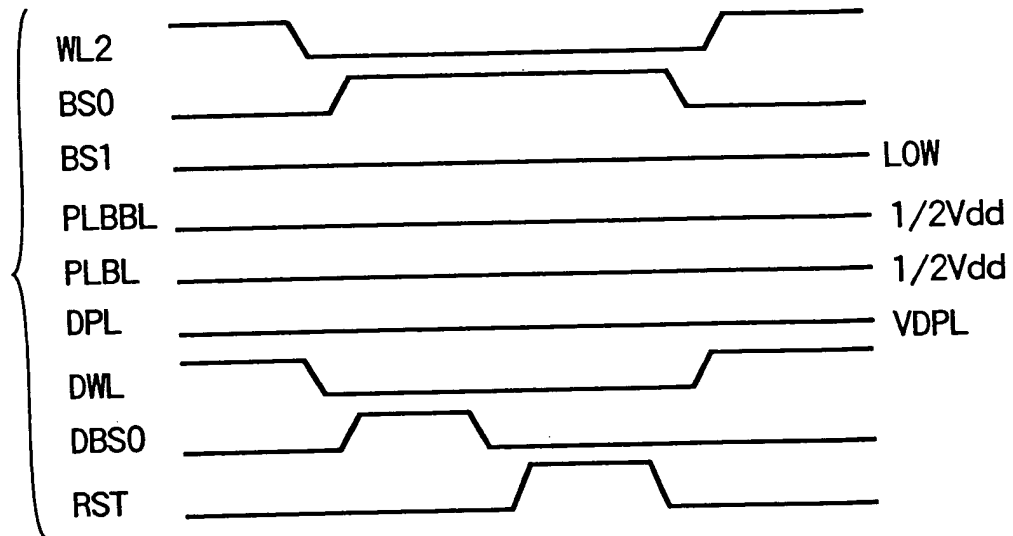


FIG. 179A

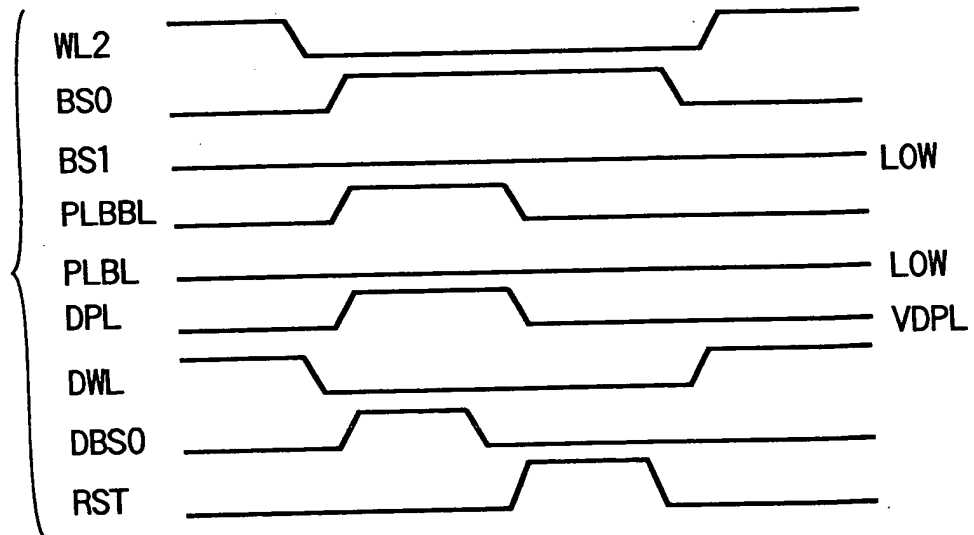


FIG. 179B

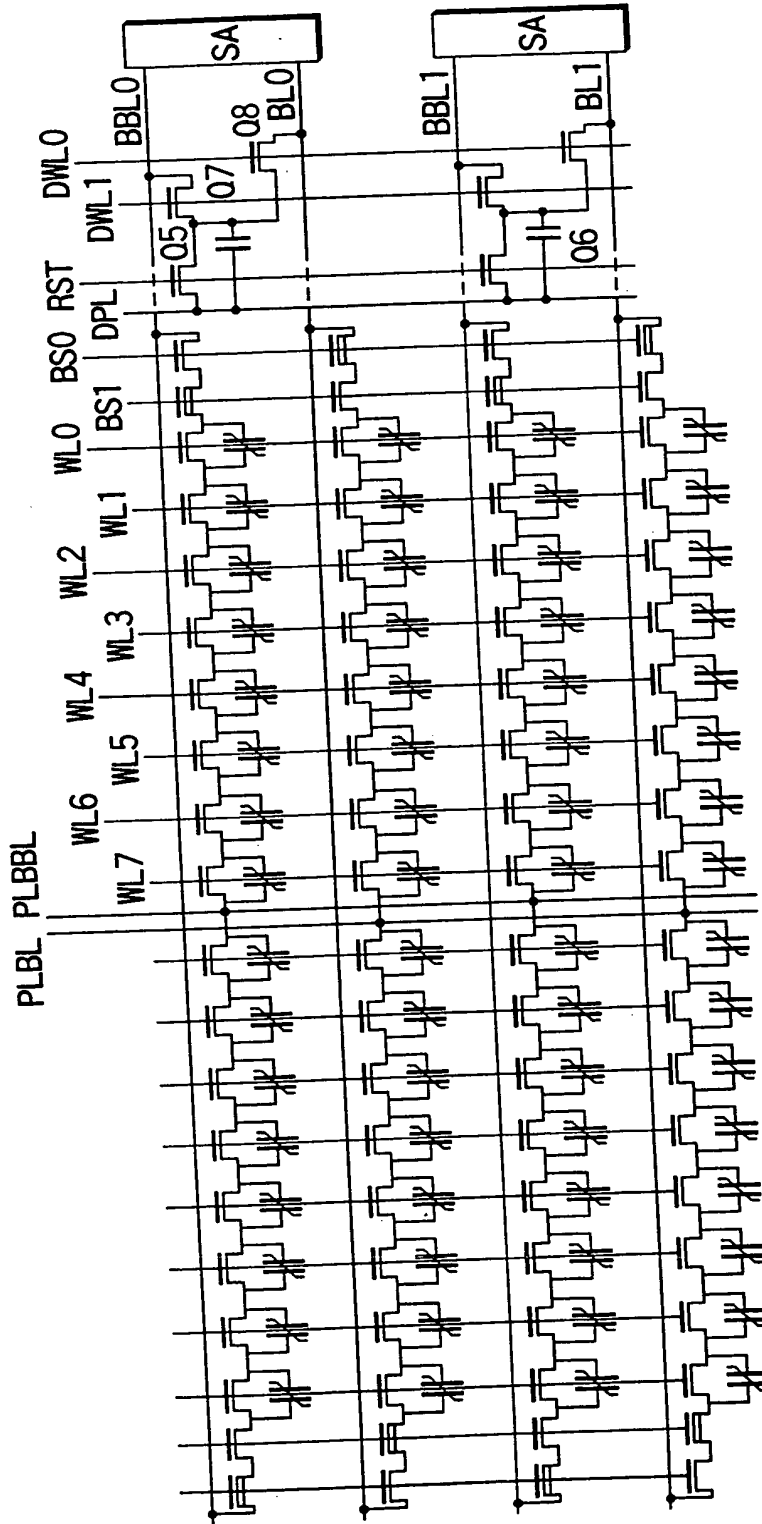


FIG. 180

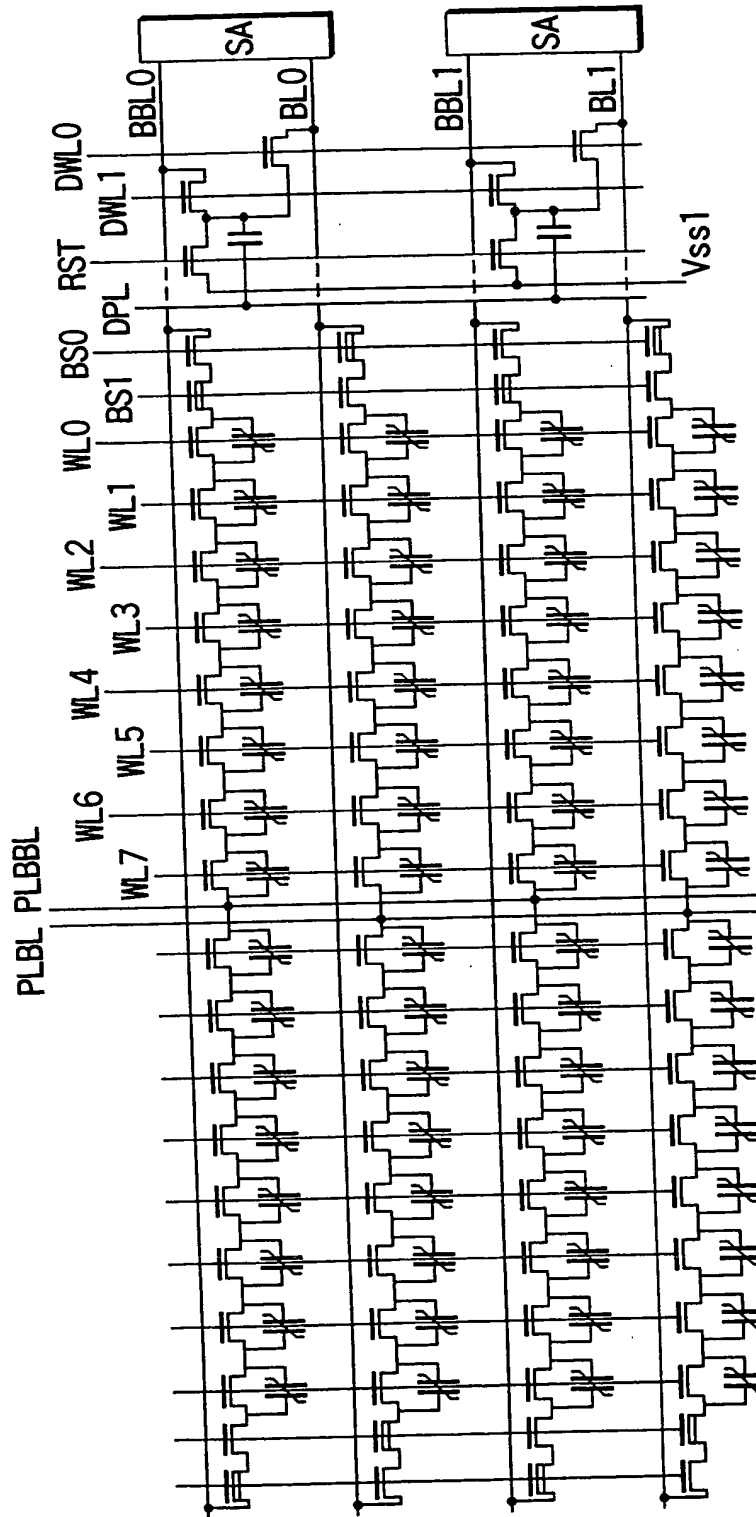


FIG.181

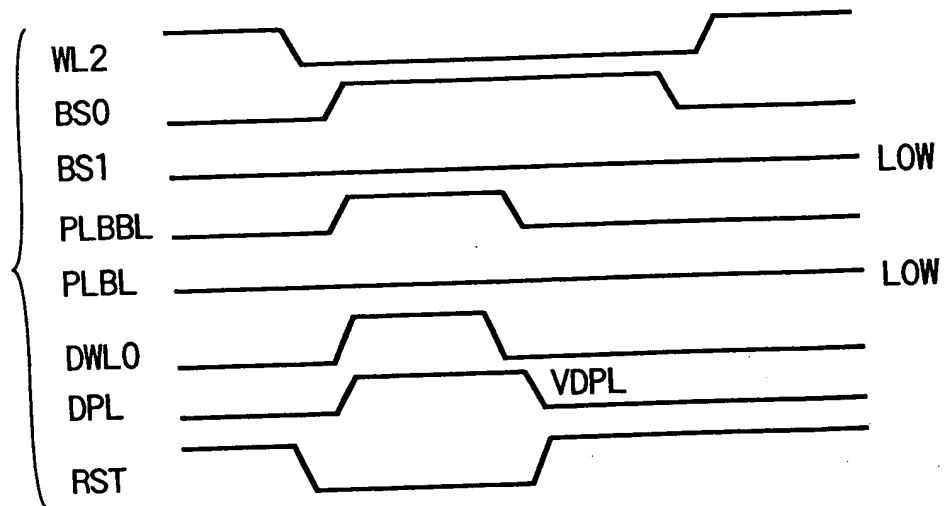


FIG. 182A

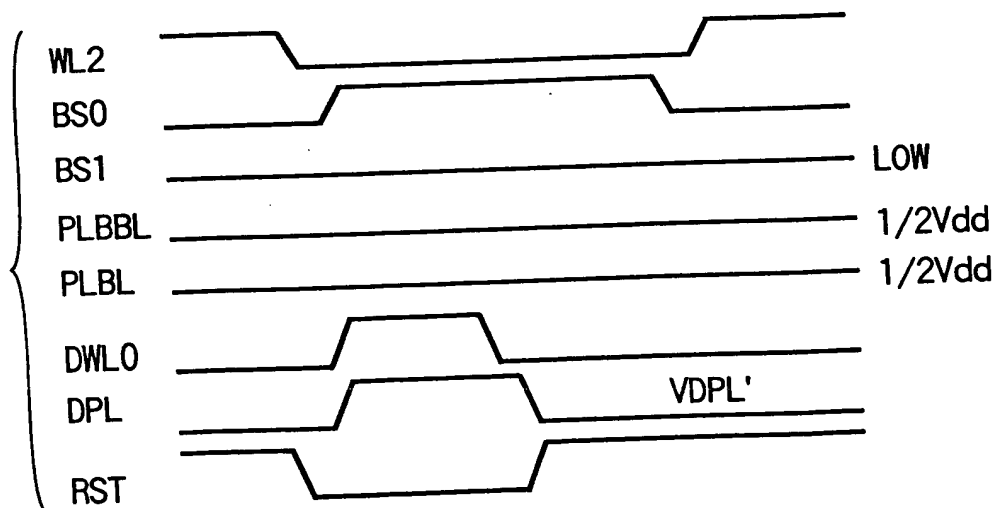


FIG. 182B

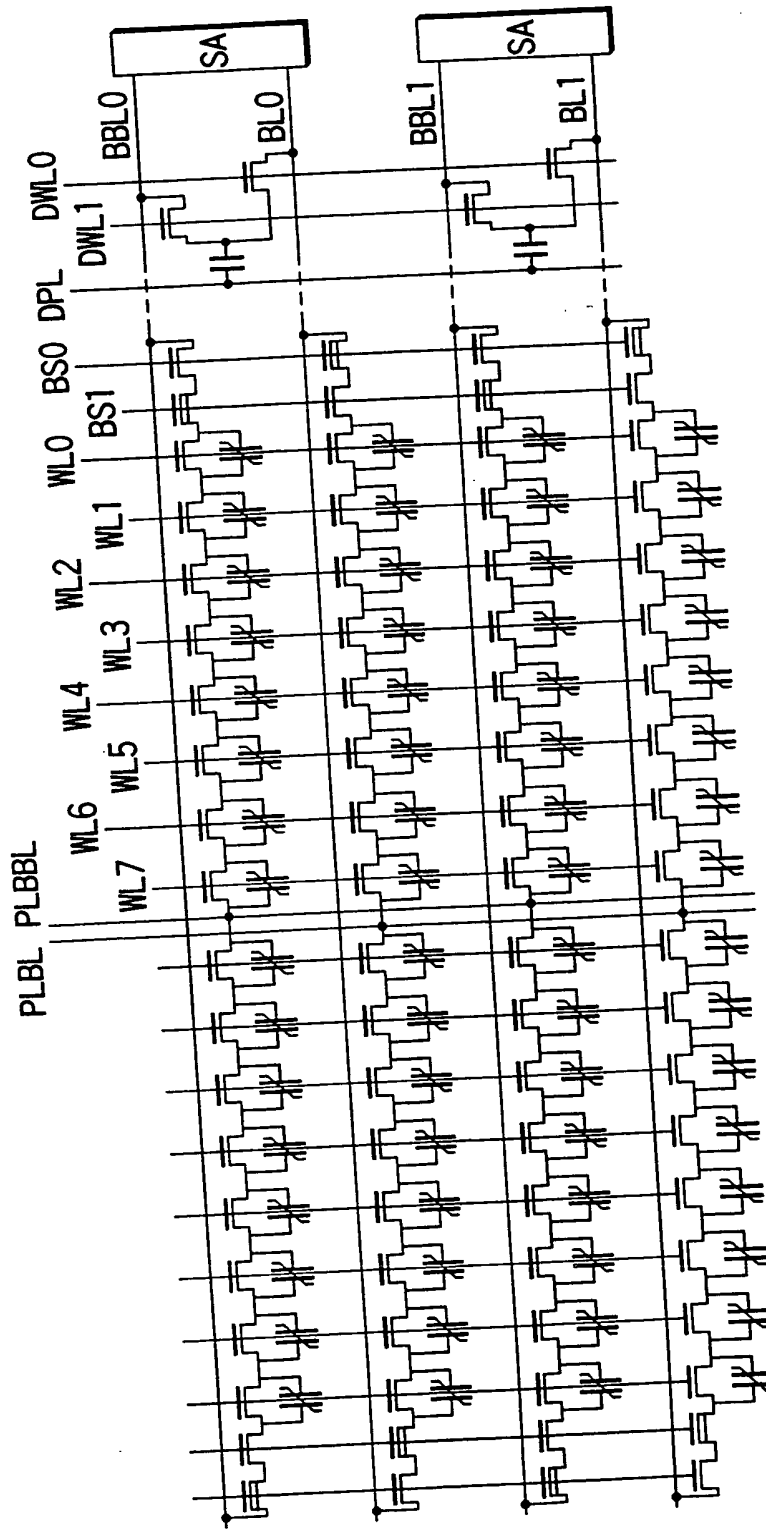


FIG. 183

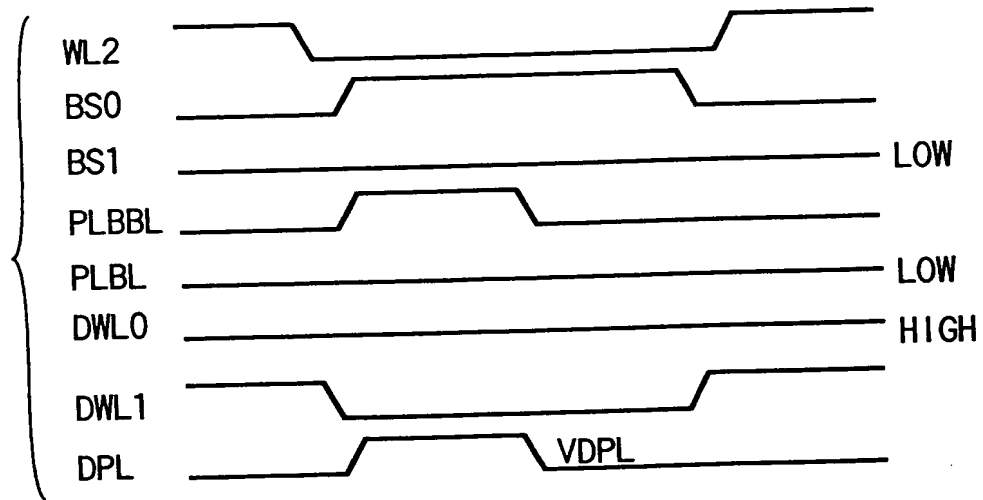


FIG. 184A

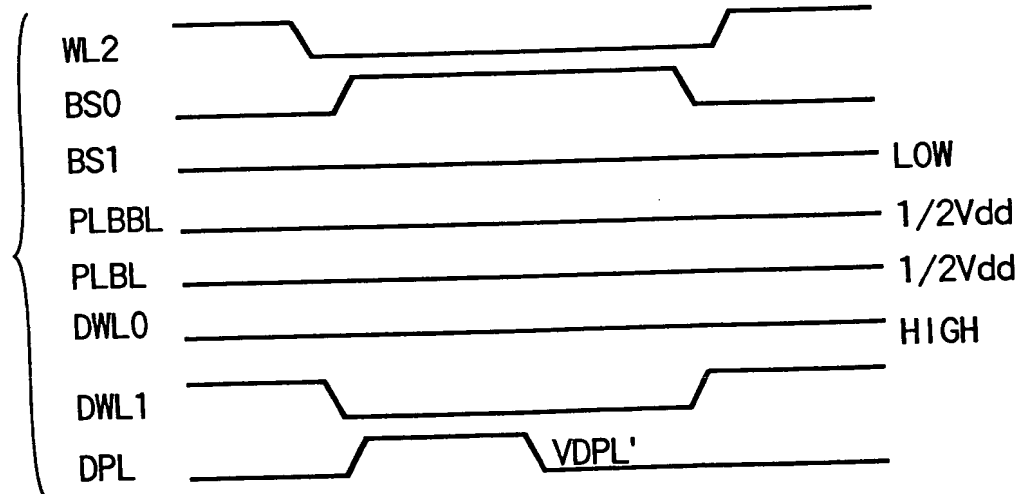


FIG. 184B

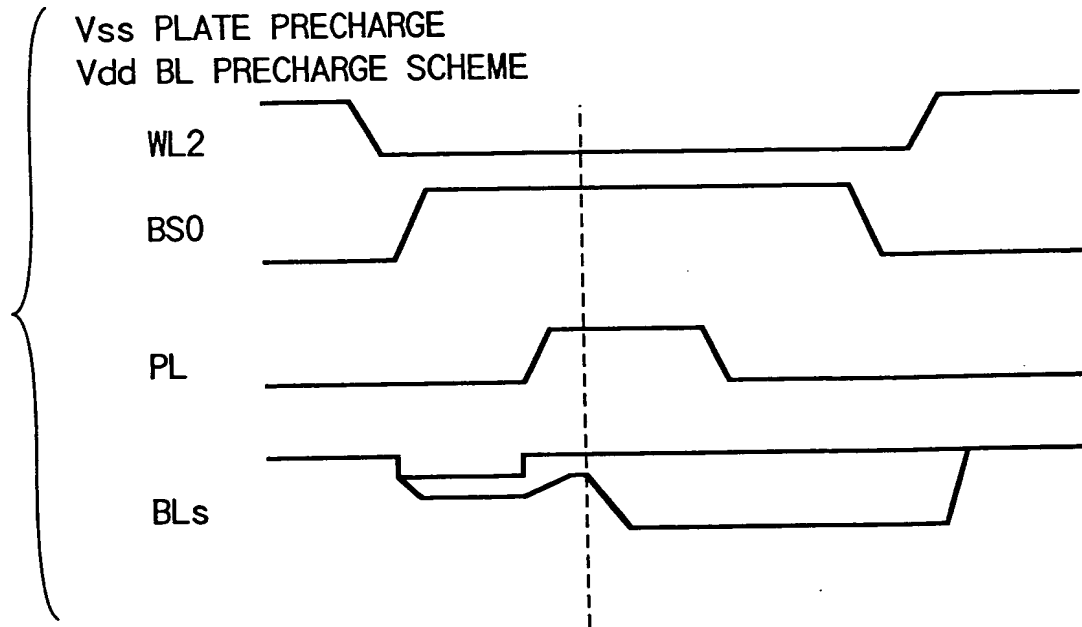


FIG. 185A

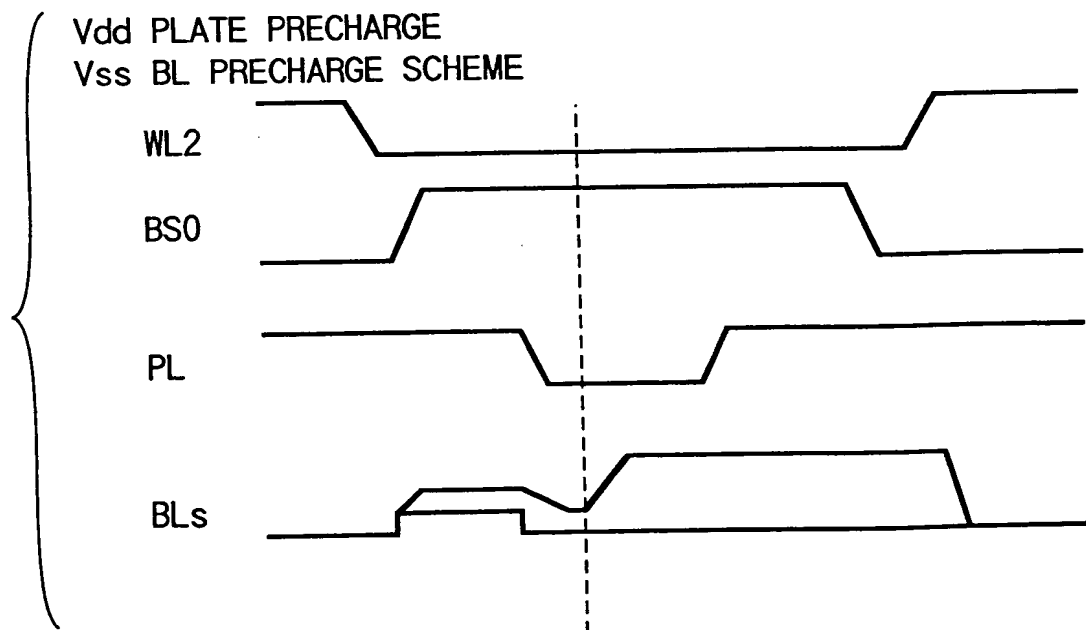


FIG. 185B

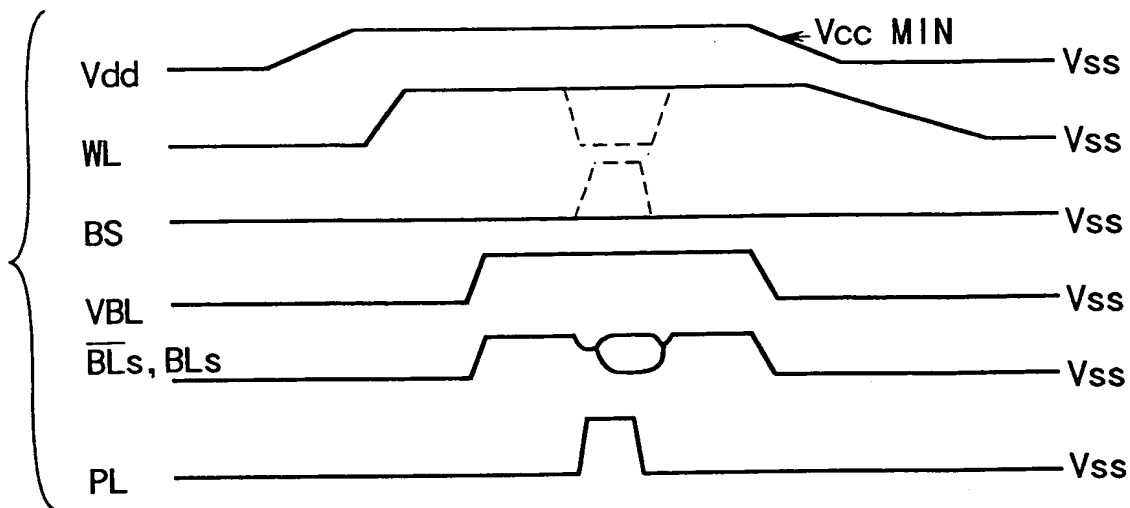


FIG. 186A

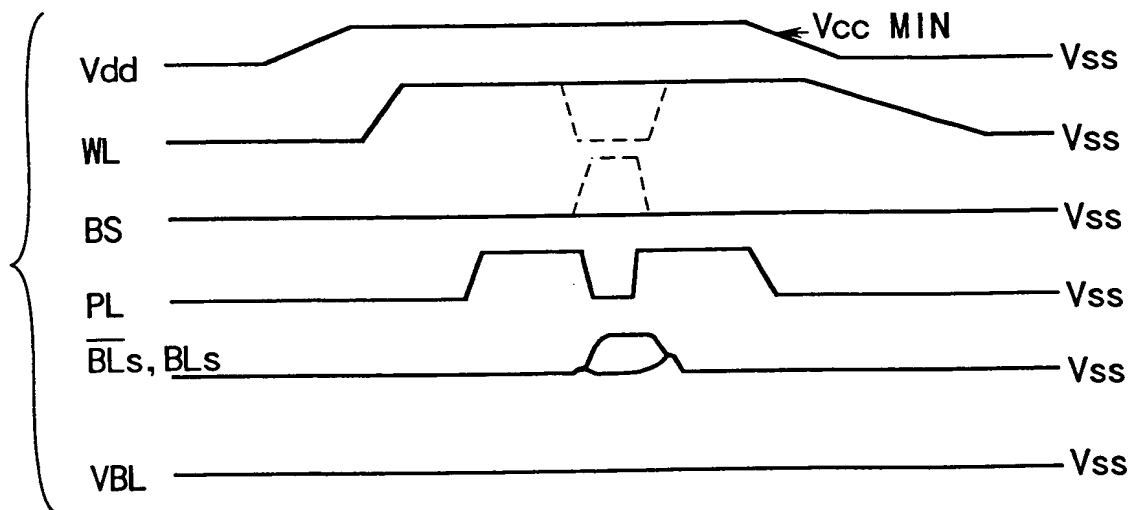


FIG. 186B

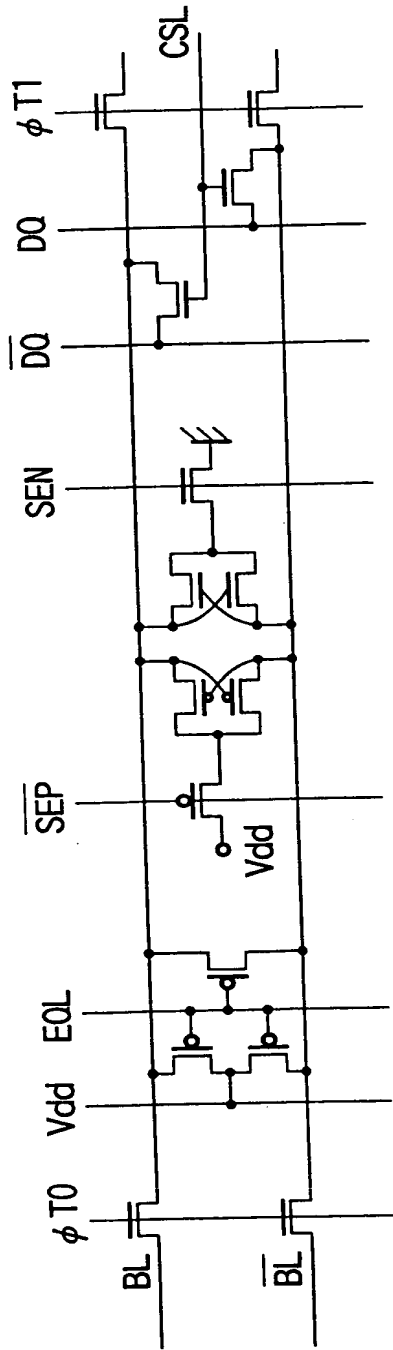


FIG. 187

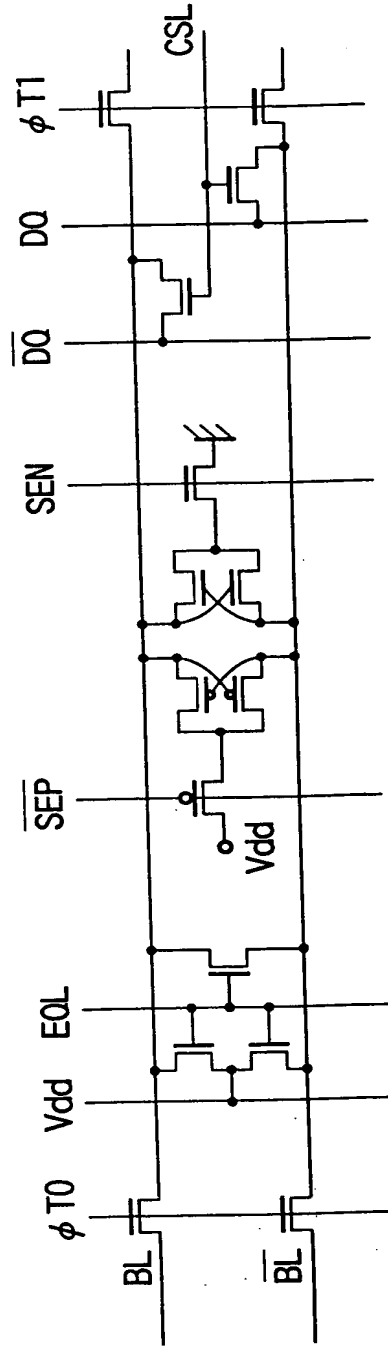
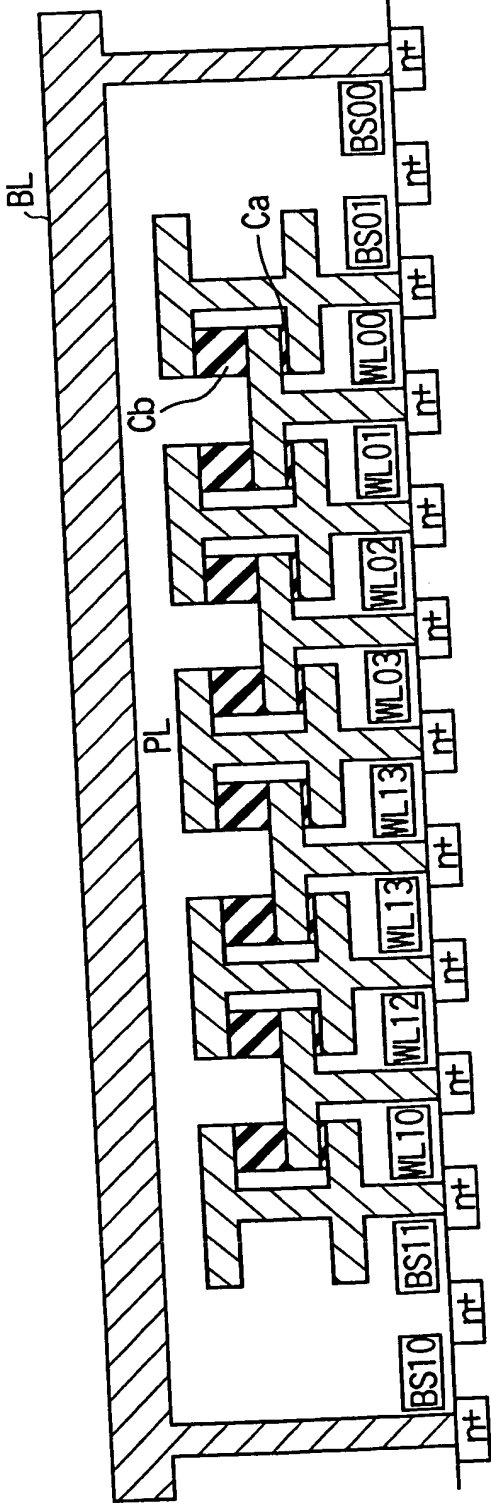


FIG. 188



THICKNESS OF Cb>THICKNESS OF Ca

FIG. 189

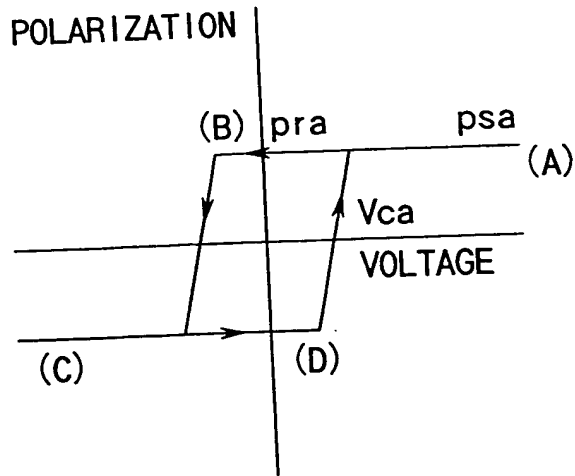


FIG. 190A

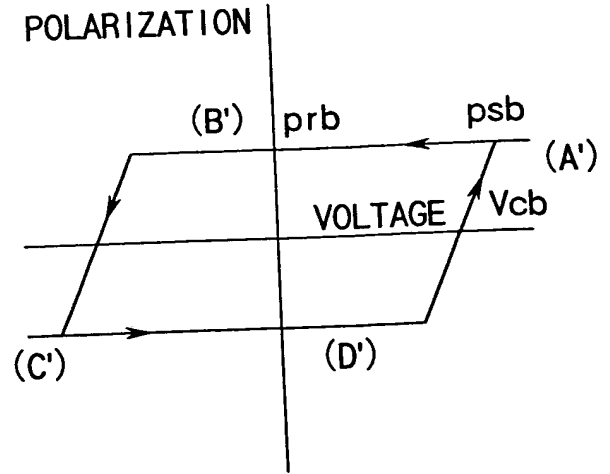


FIG. 190B

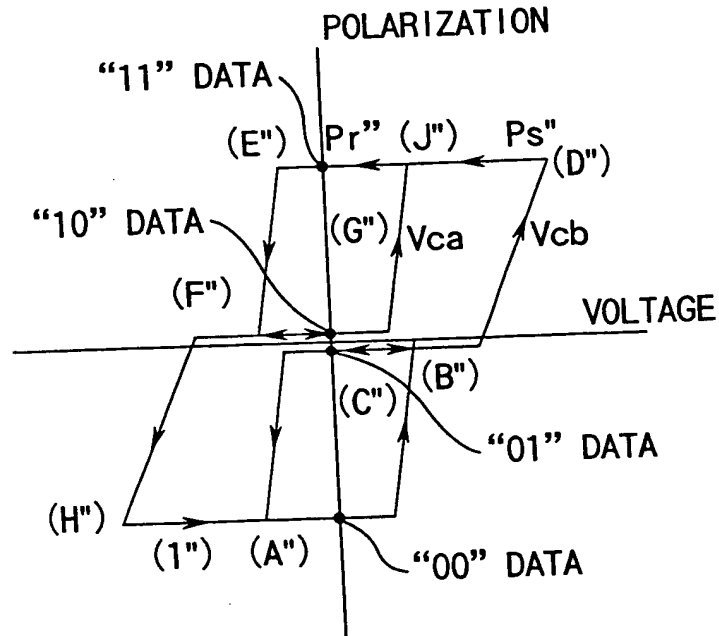


FIG. 190C

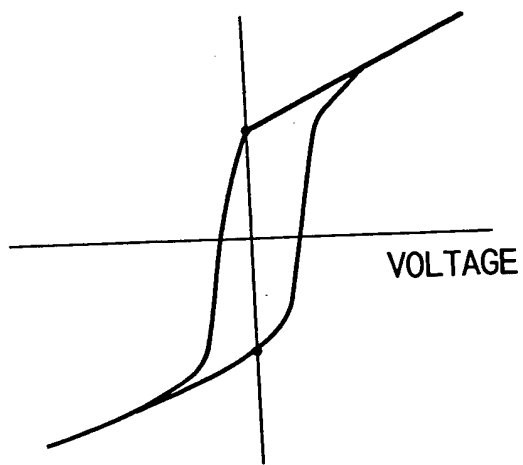


FIG. 191A

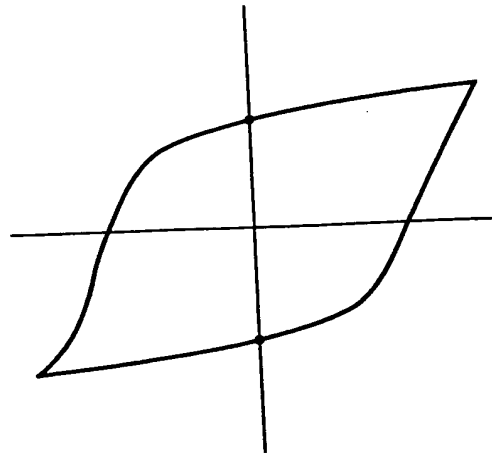


FIG. 191B

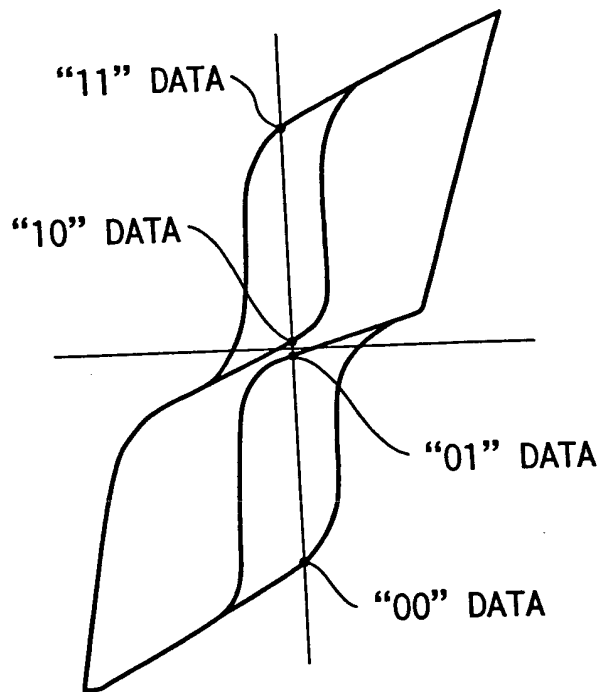


FIG. 191C

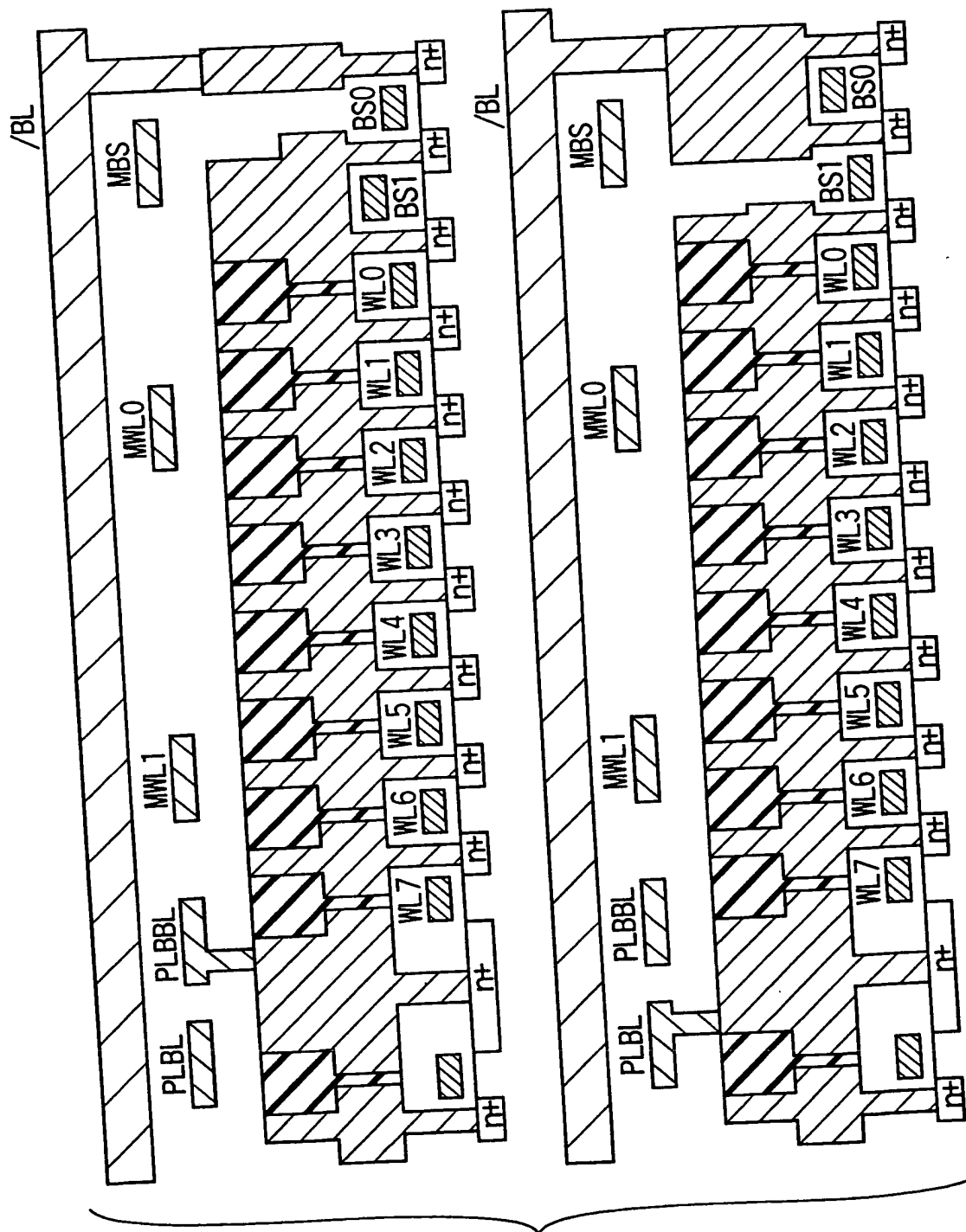


FIG. 192

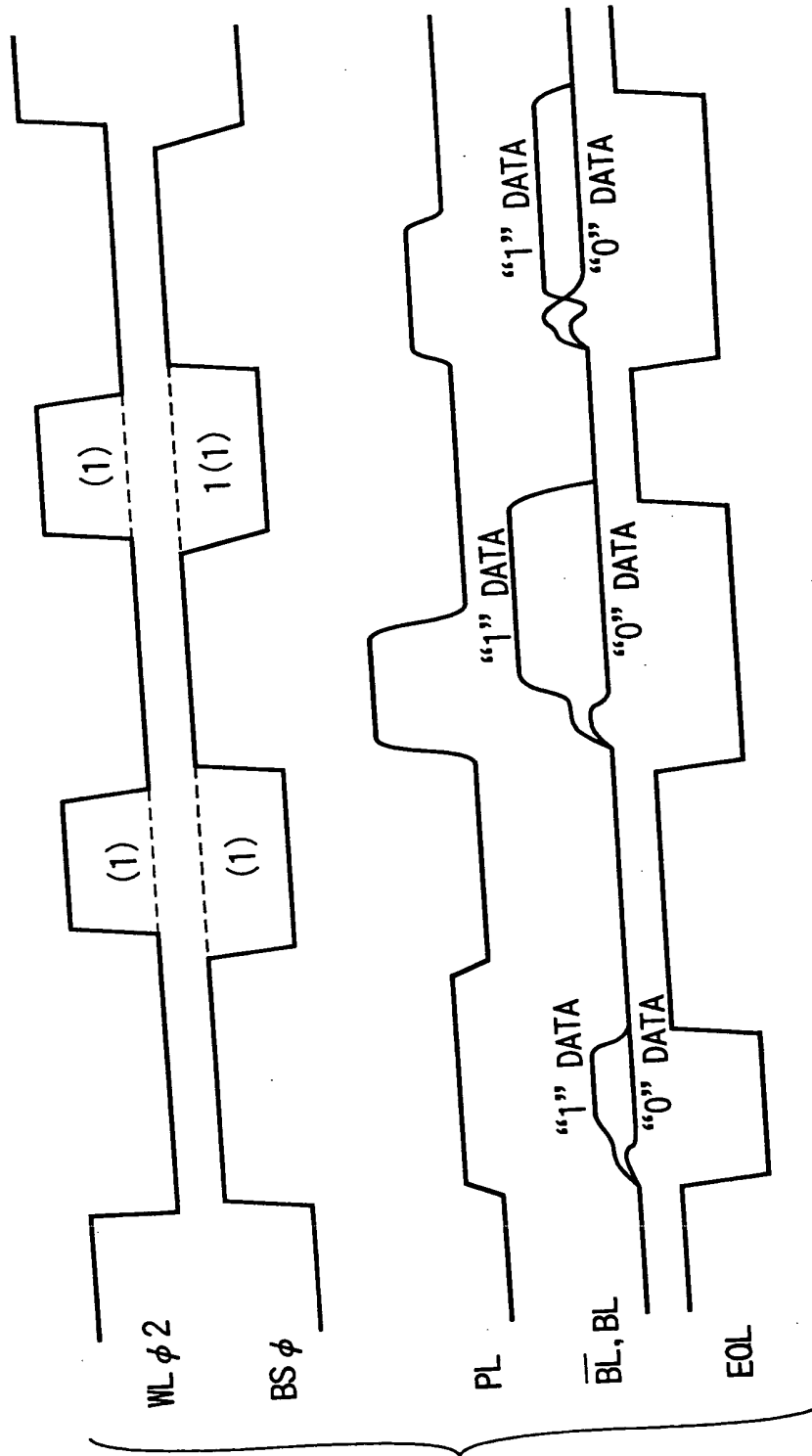


FIG. 193

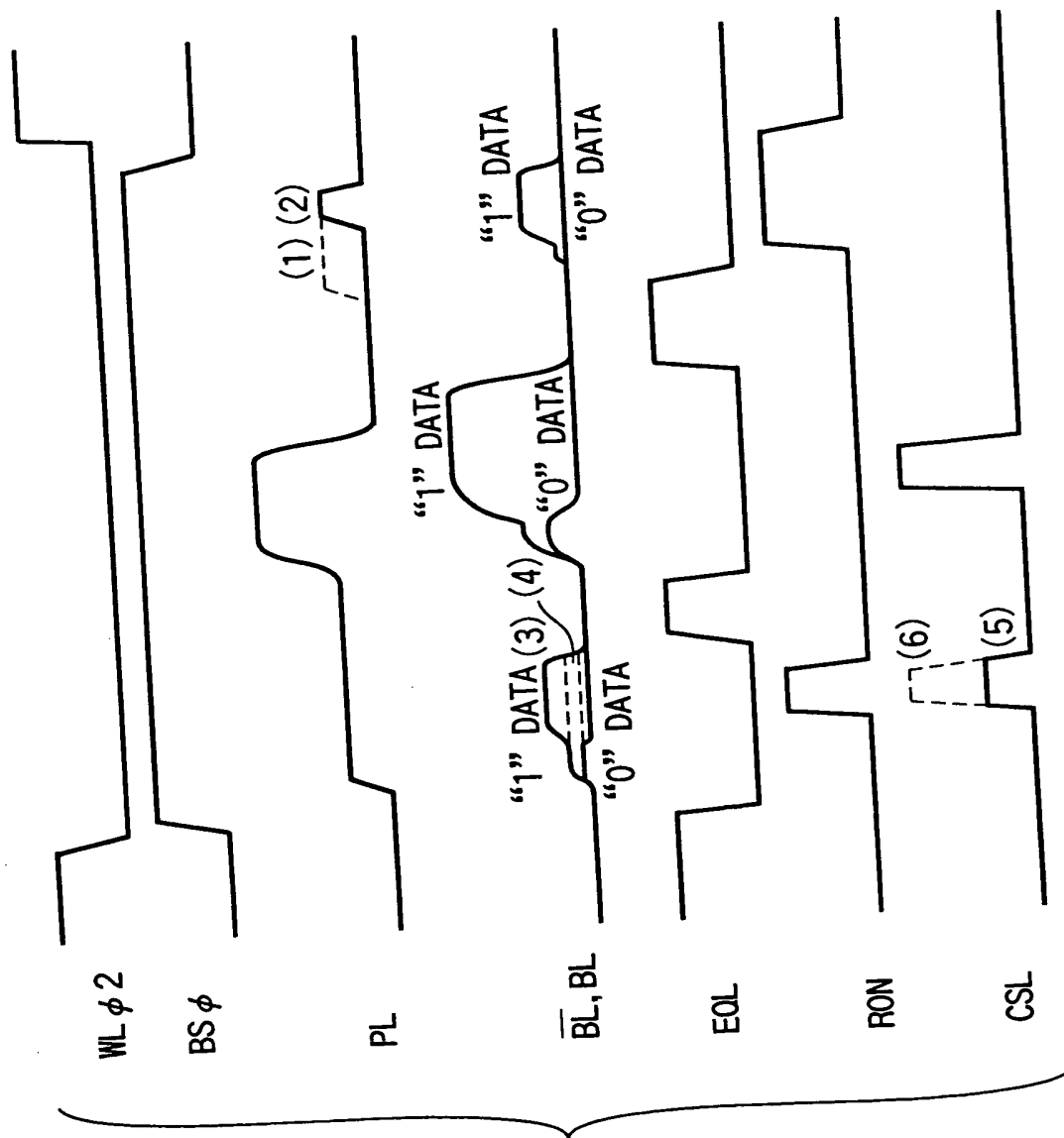


FIG. 194

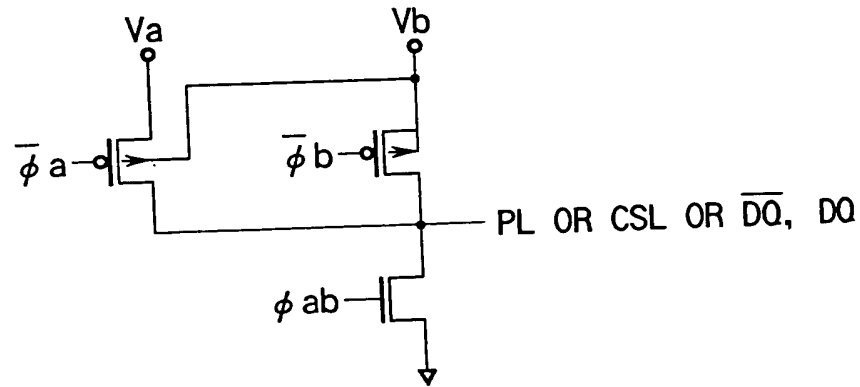


FIG. 195A

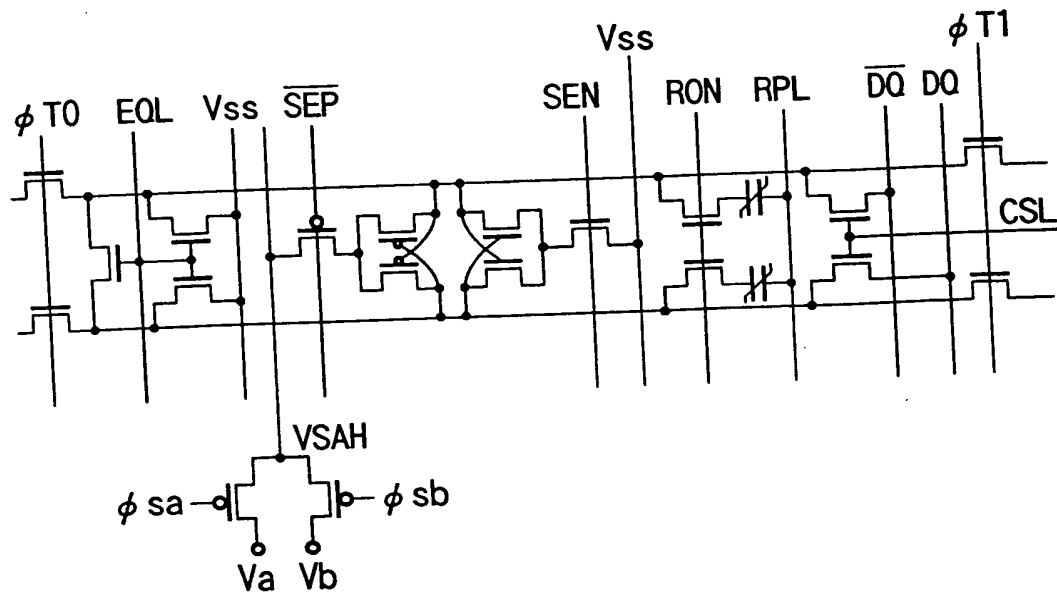


FIG. 195B

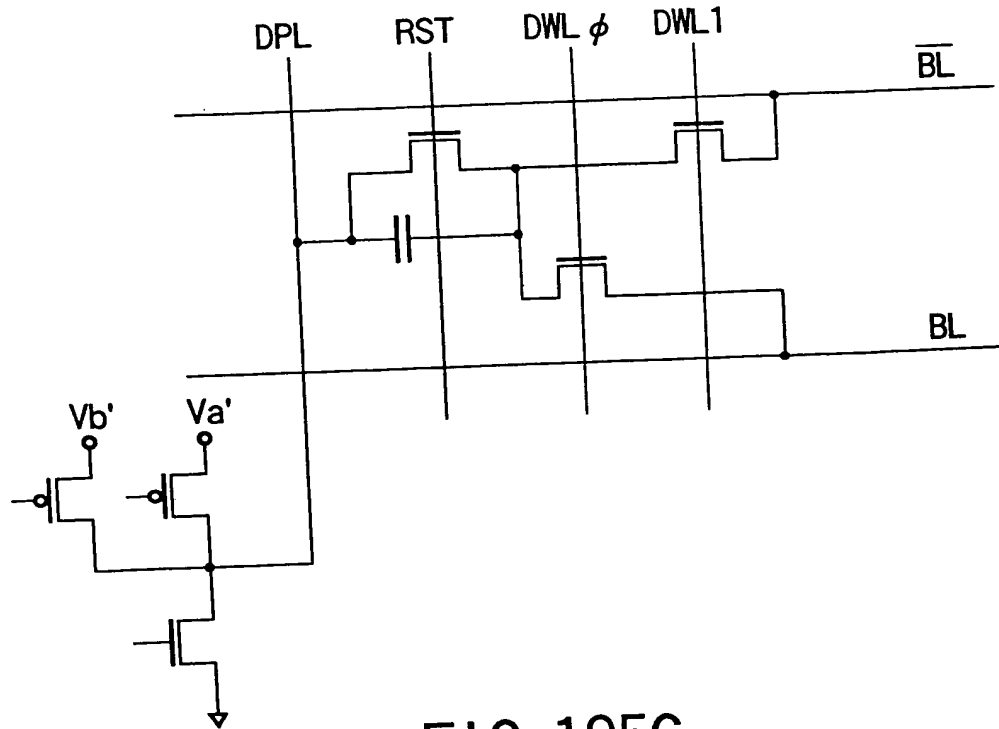


FIG. 195C

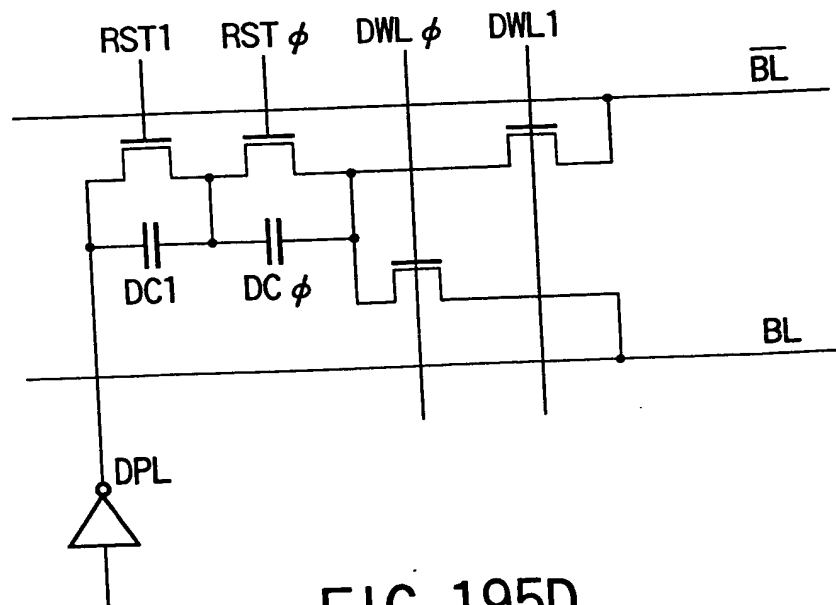


FIG. 195D

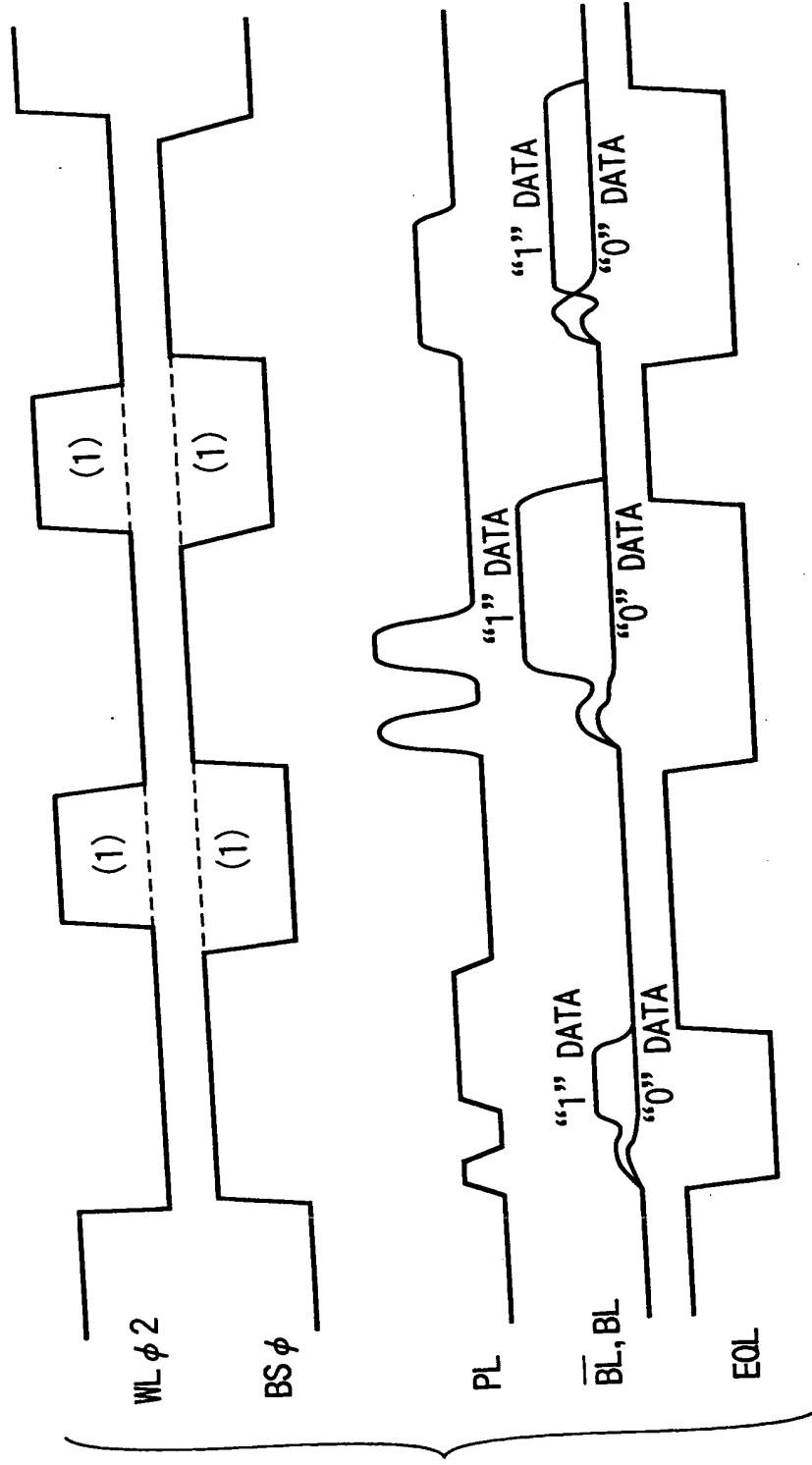


FIG. 196

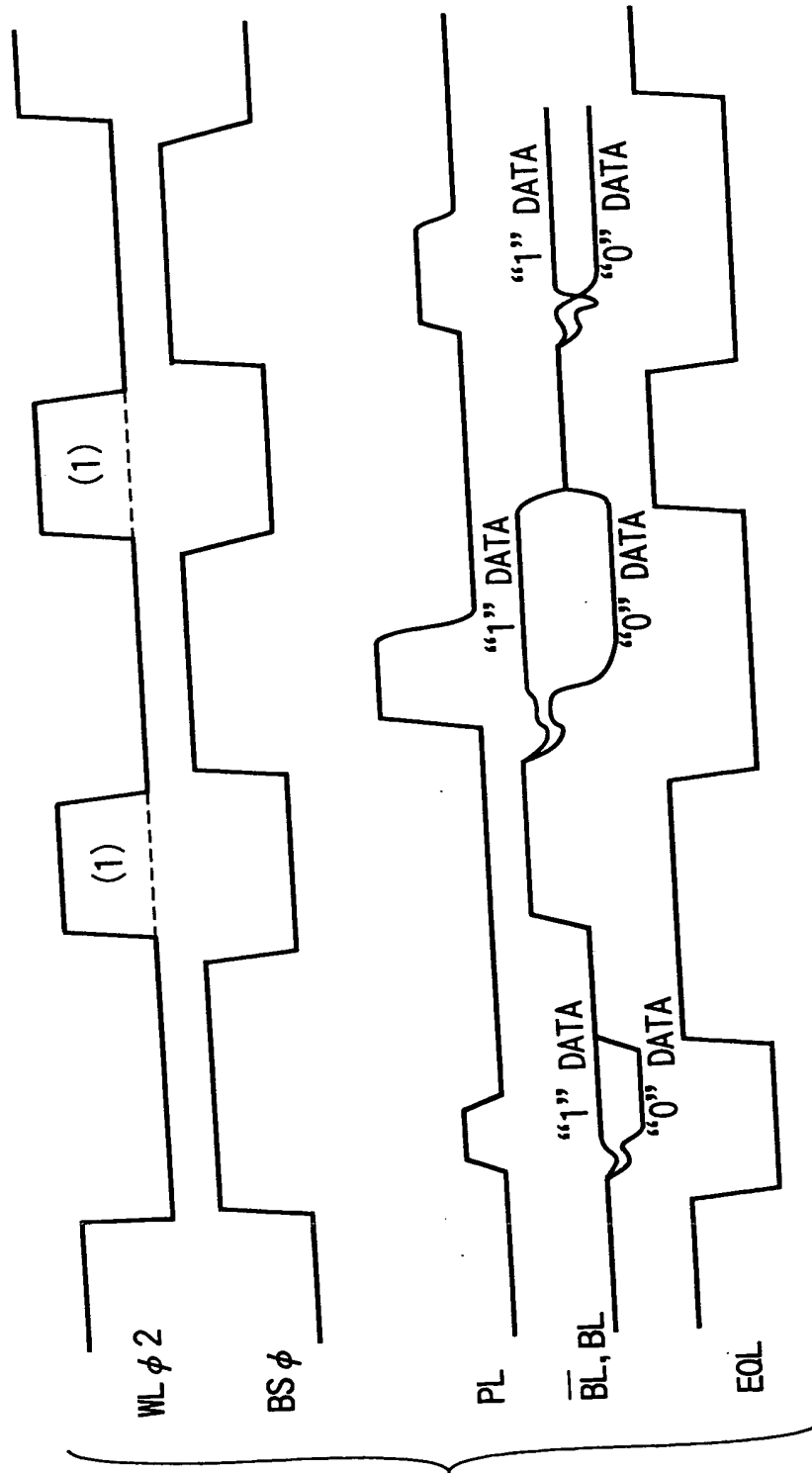


FIG. 197

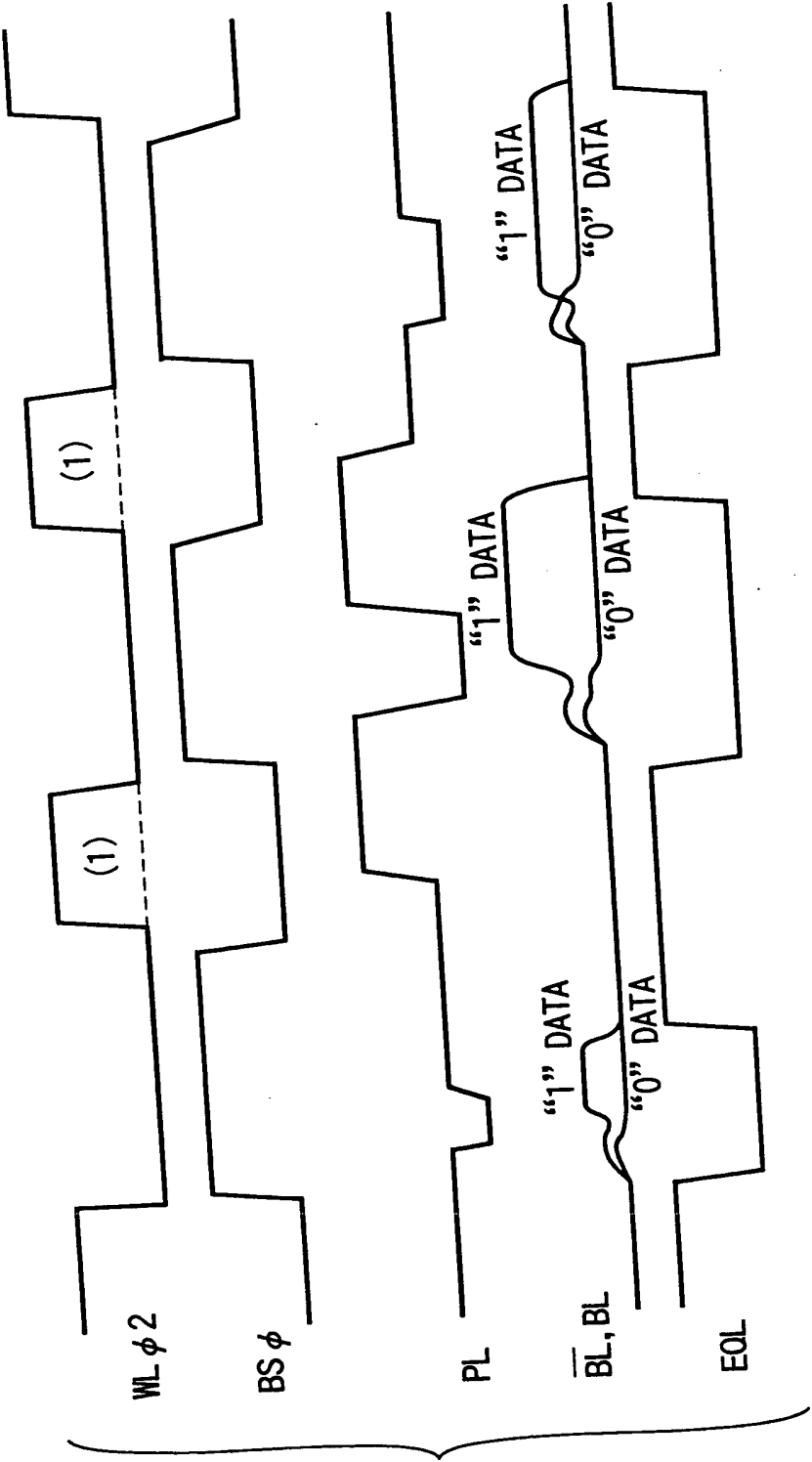


FIG. 198

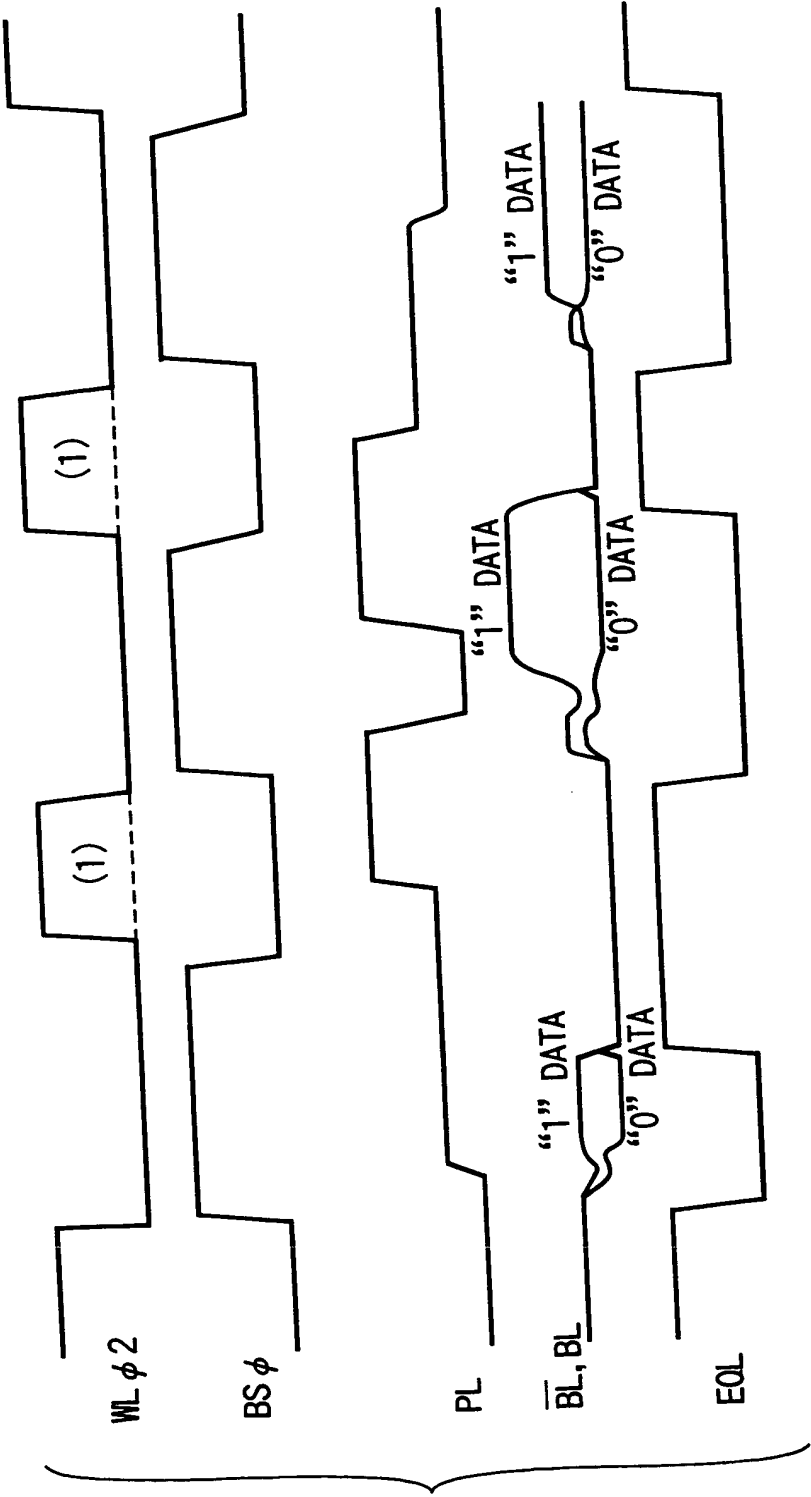


FIG. 199

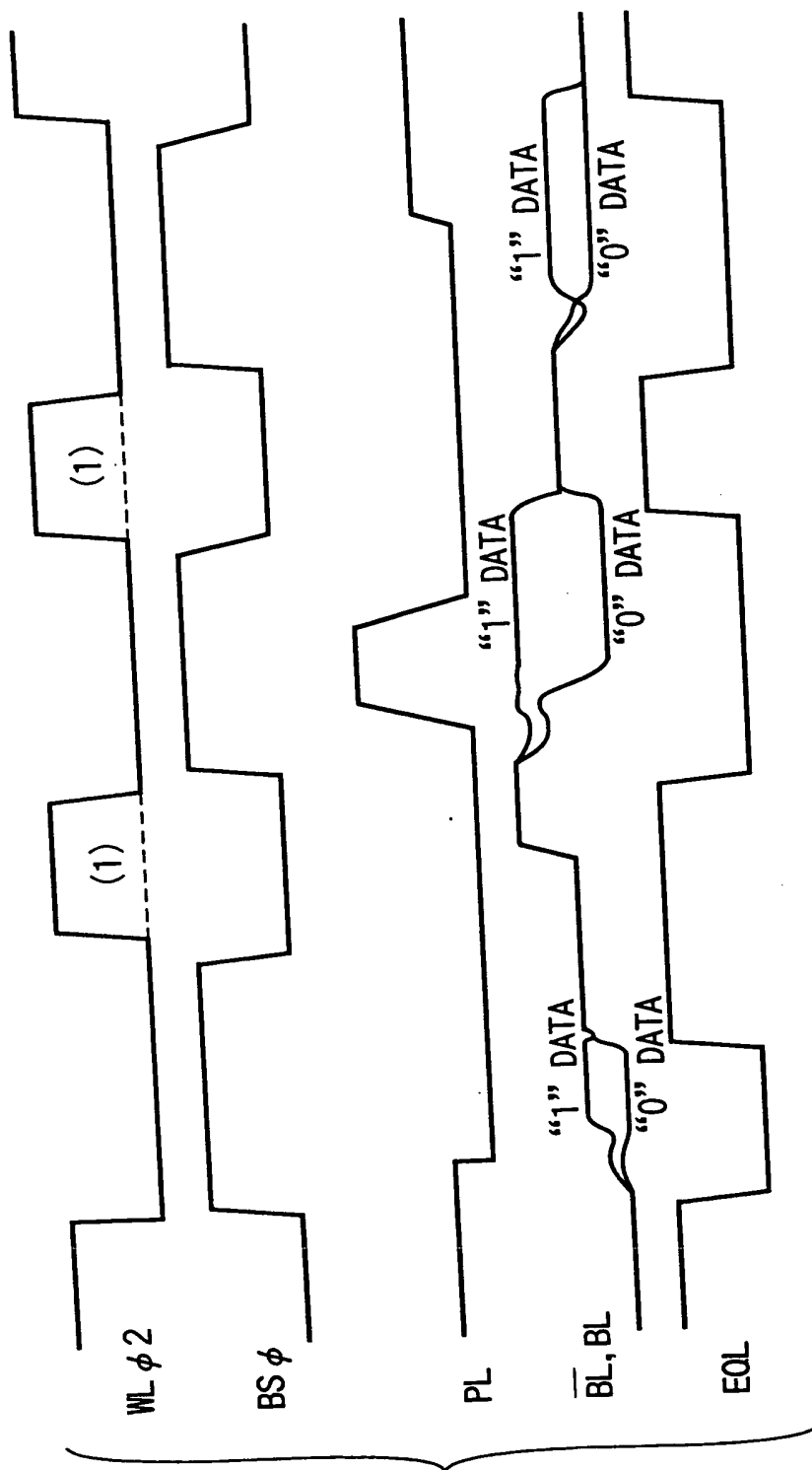


FIG. 200

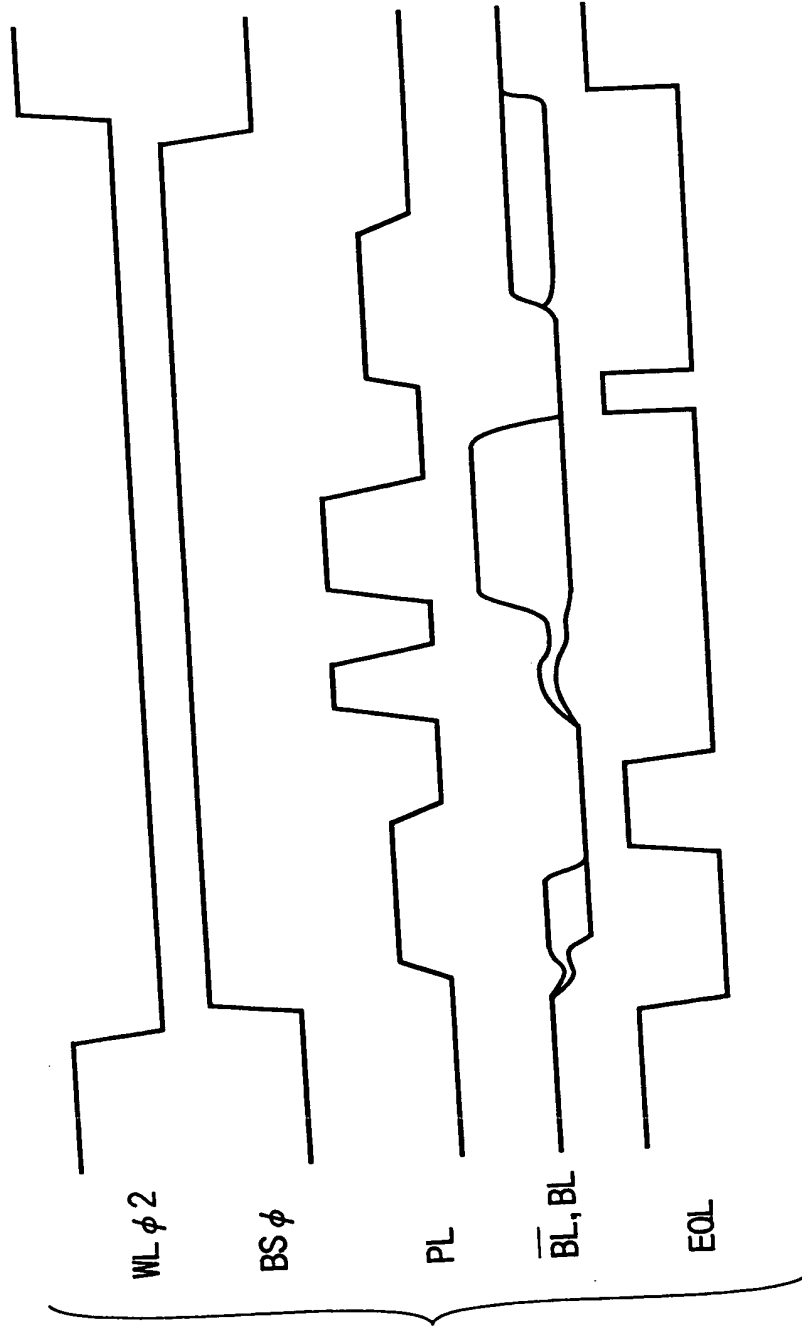


FIG. 201

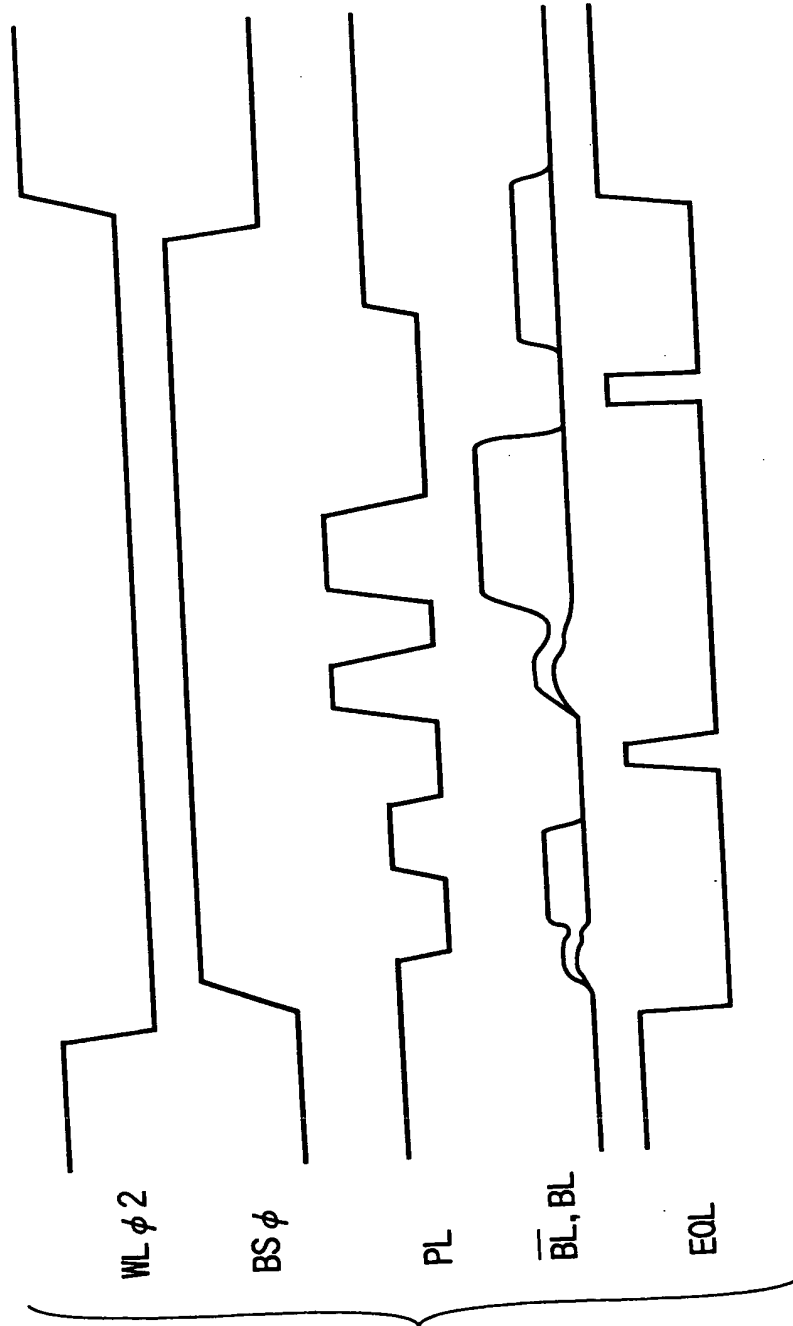


FIG. 202

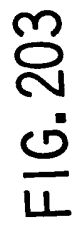


FIG. 203

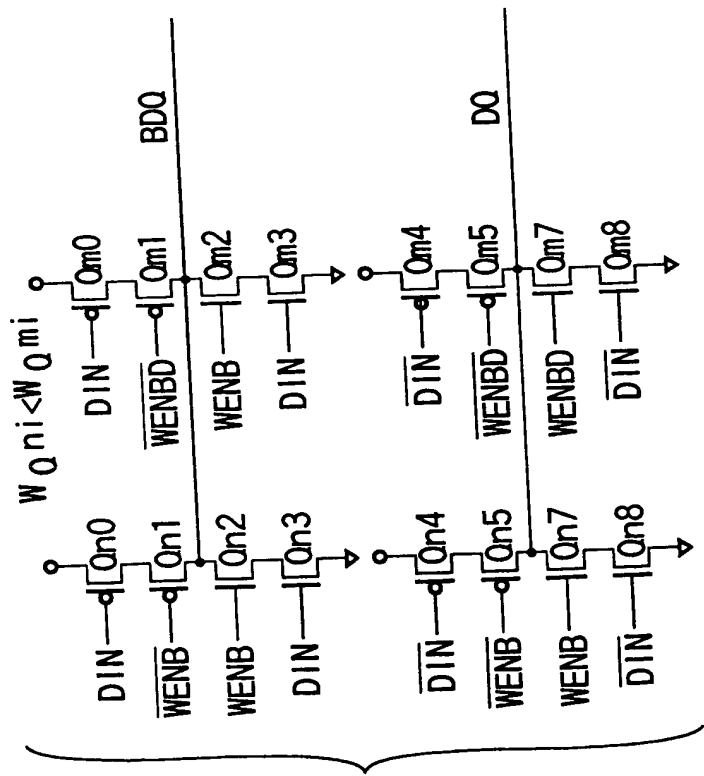


FIG. 204A

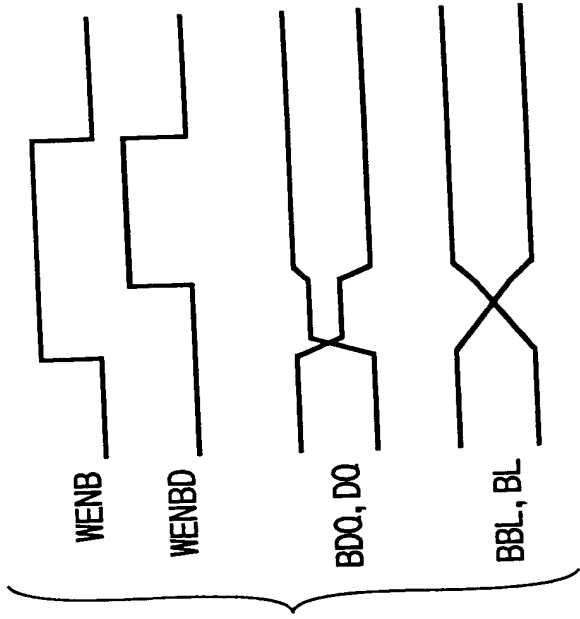


FIG. 204C

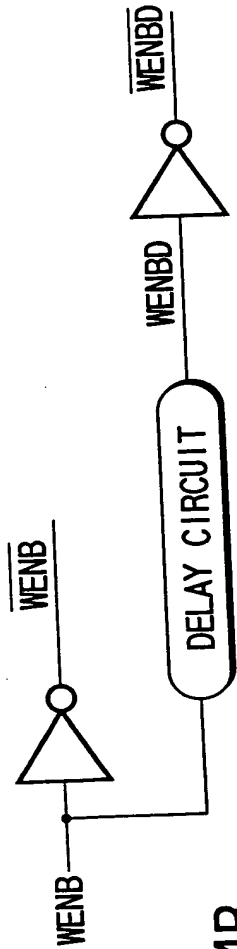


FIG. 204B

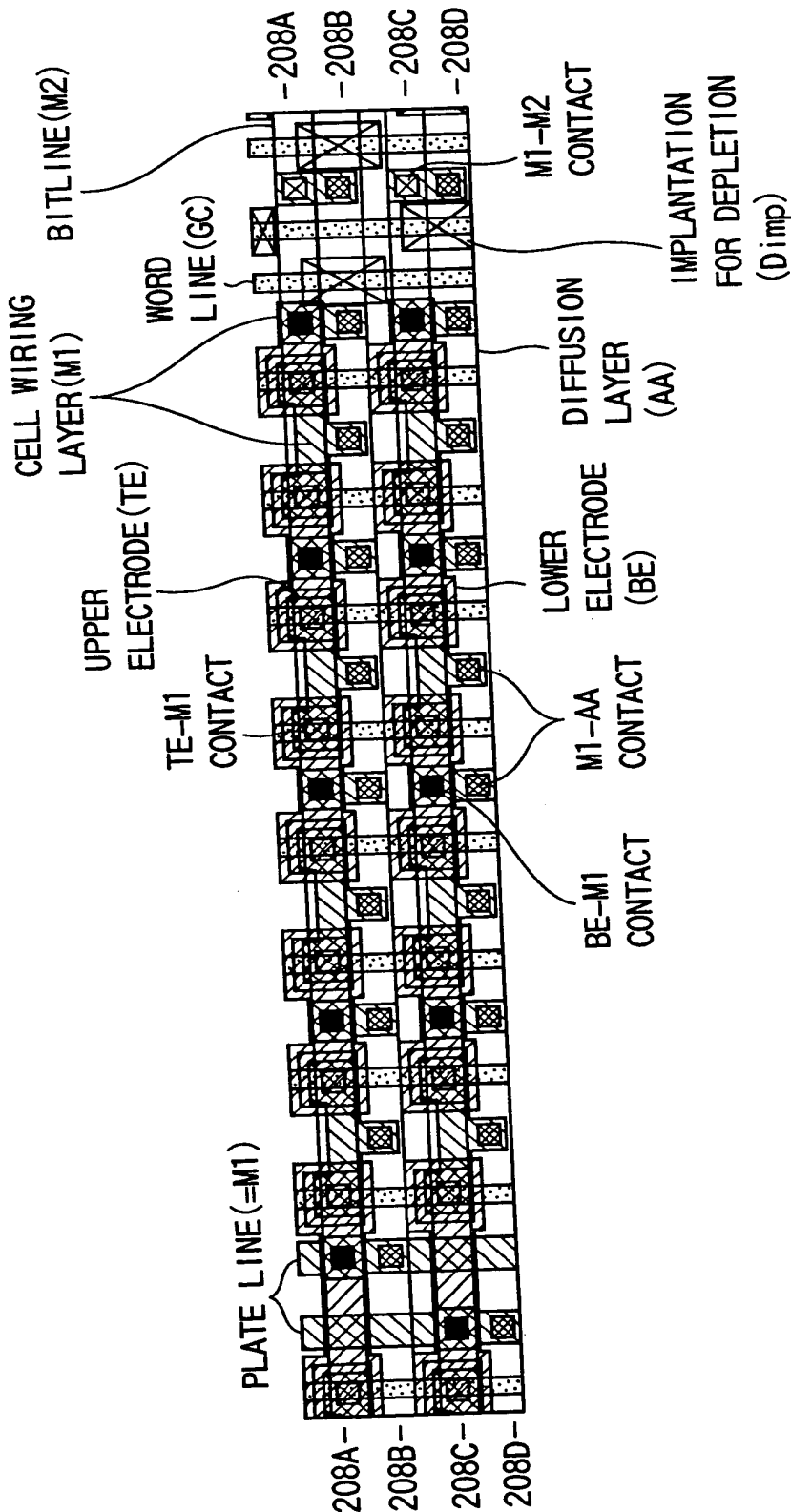


FIG. 205

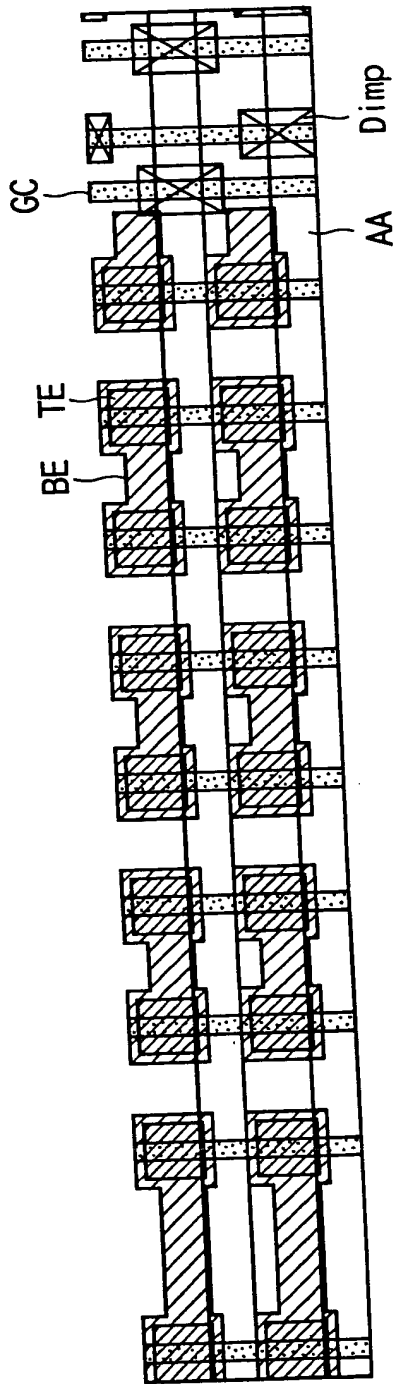


FIG. 206

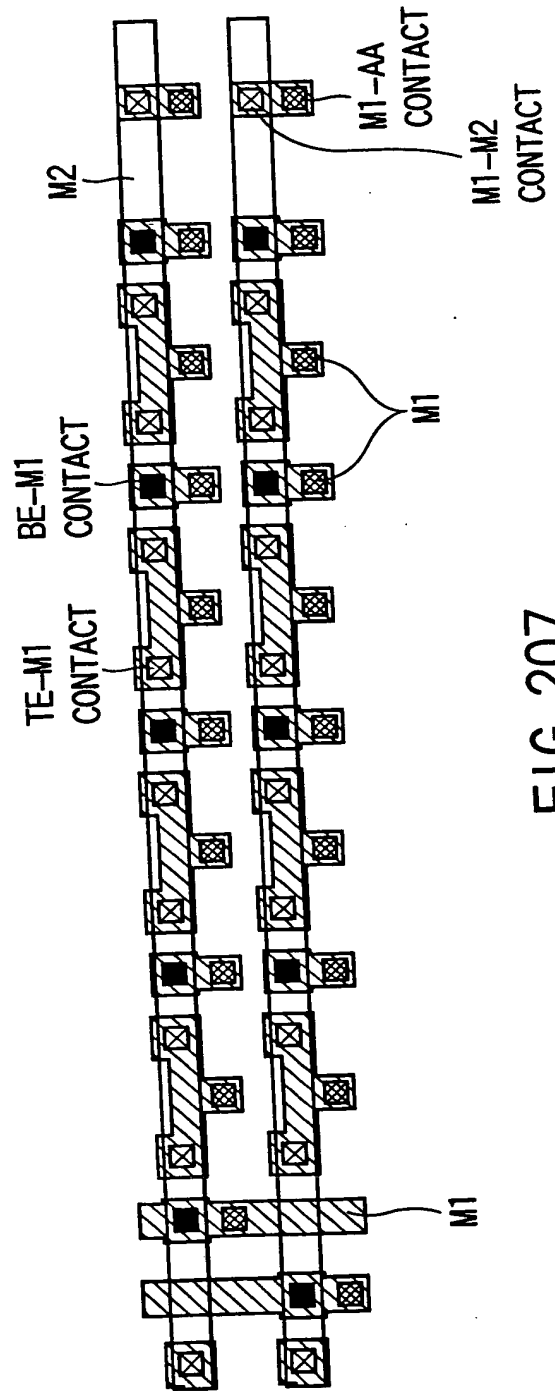


FIG. 207

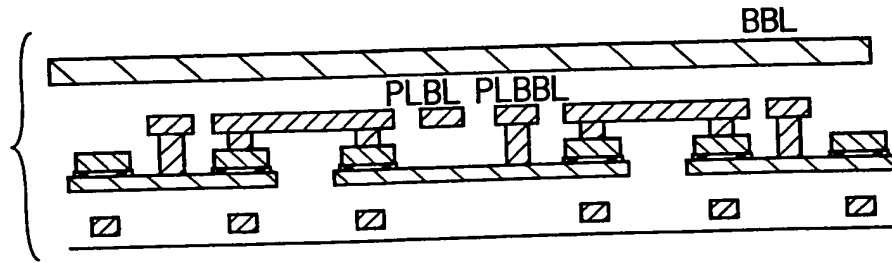


FIG. 208A

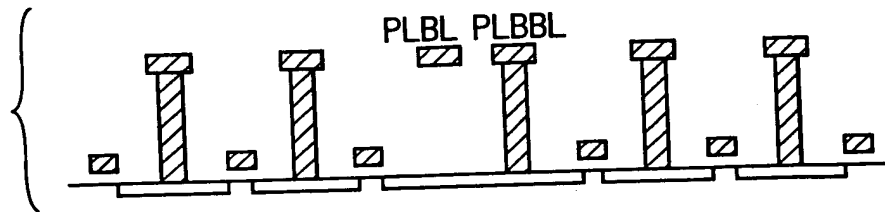


FIG. 208B

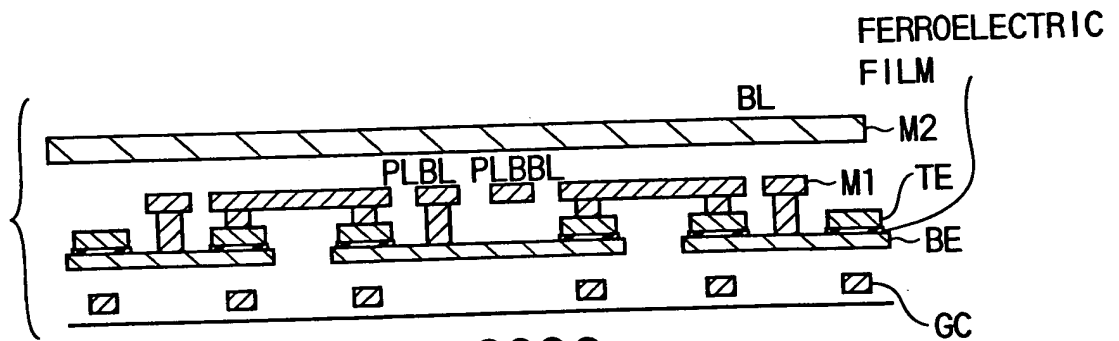


FIG. 208C

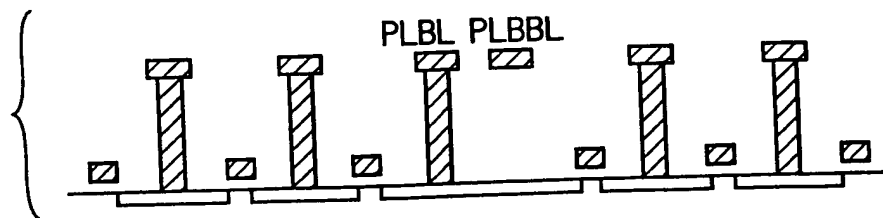


FIG. 208D

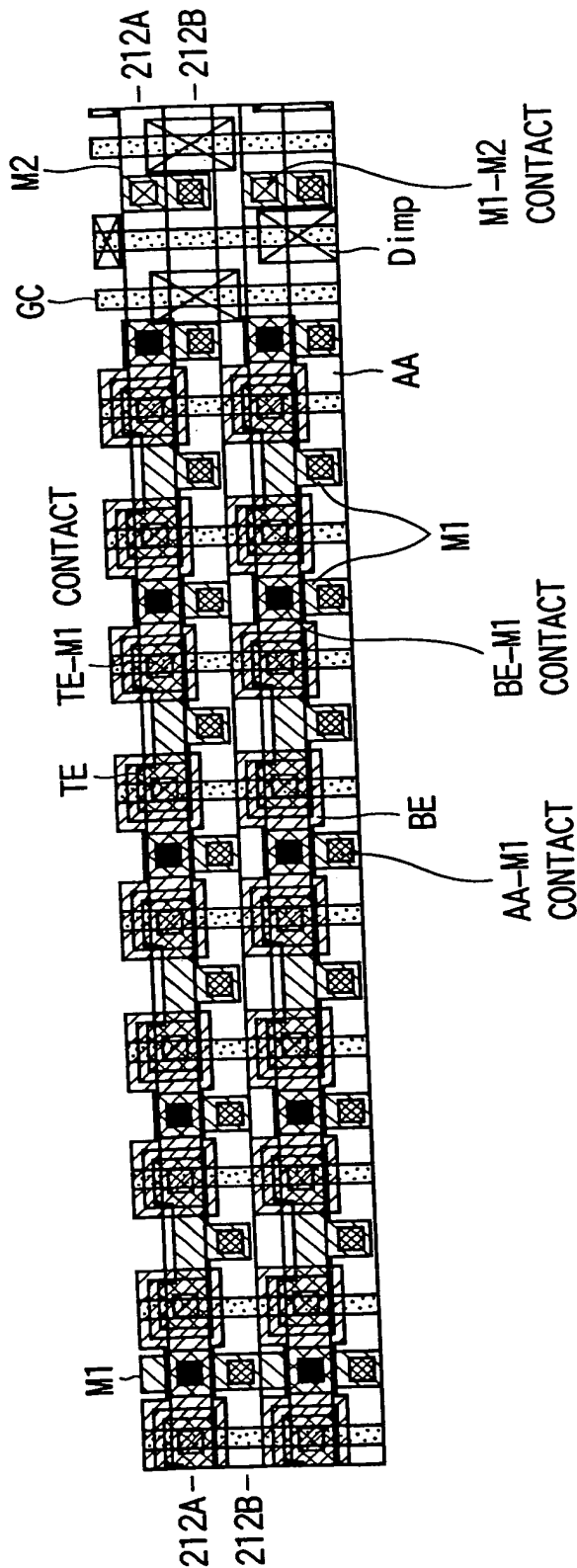


FIG. 209

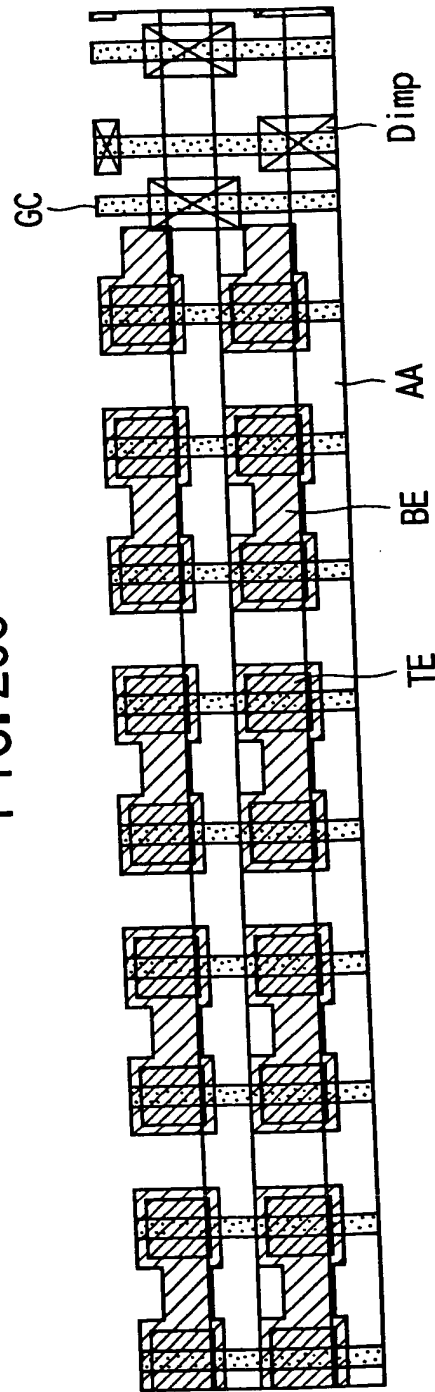


FIG. 210

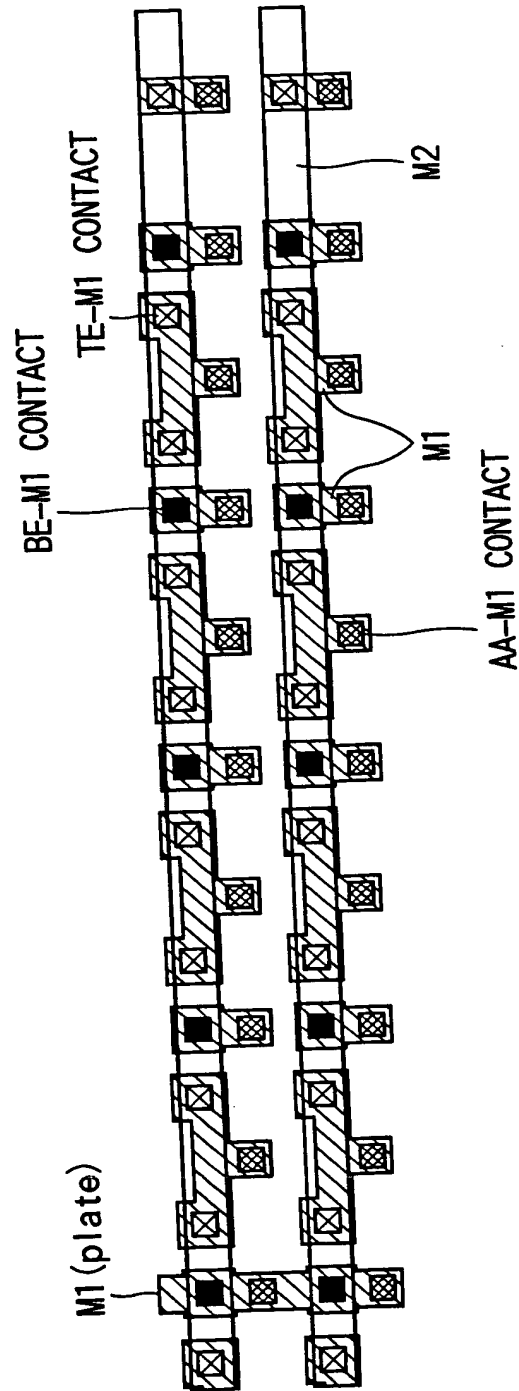


FIG. 211

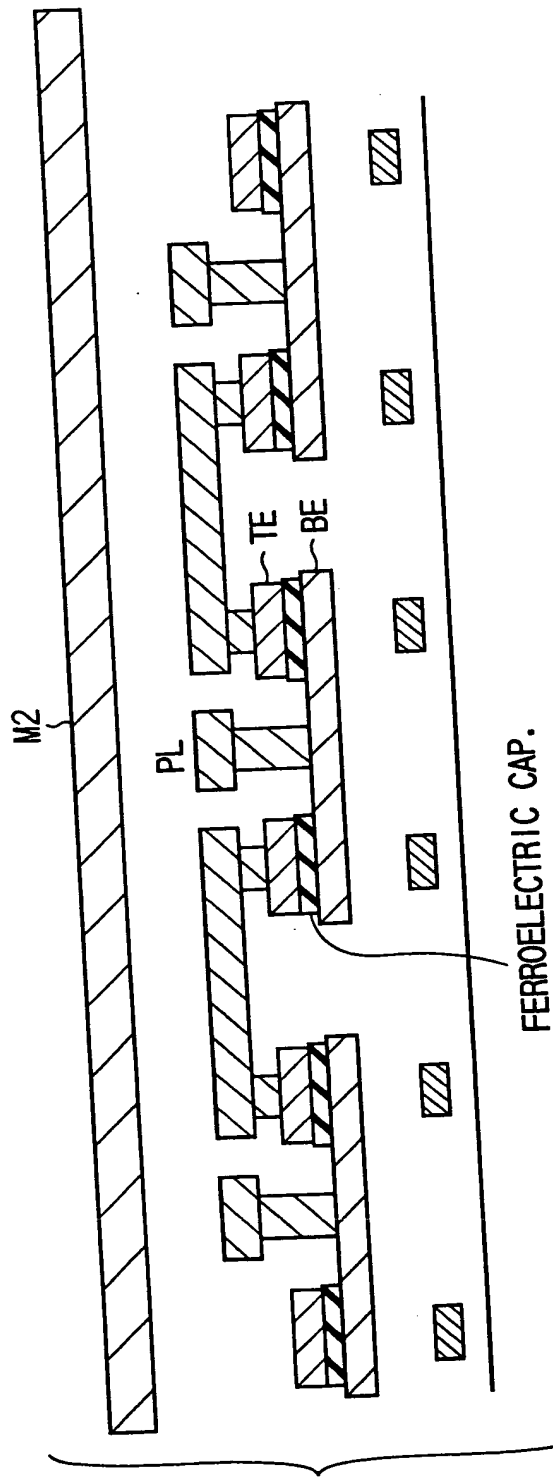


FIG. 212A

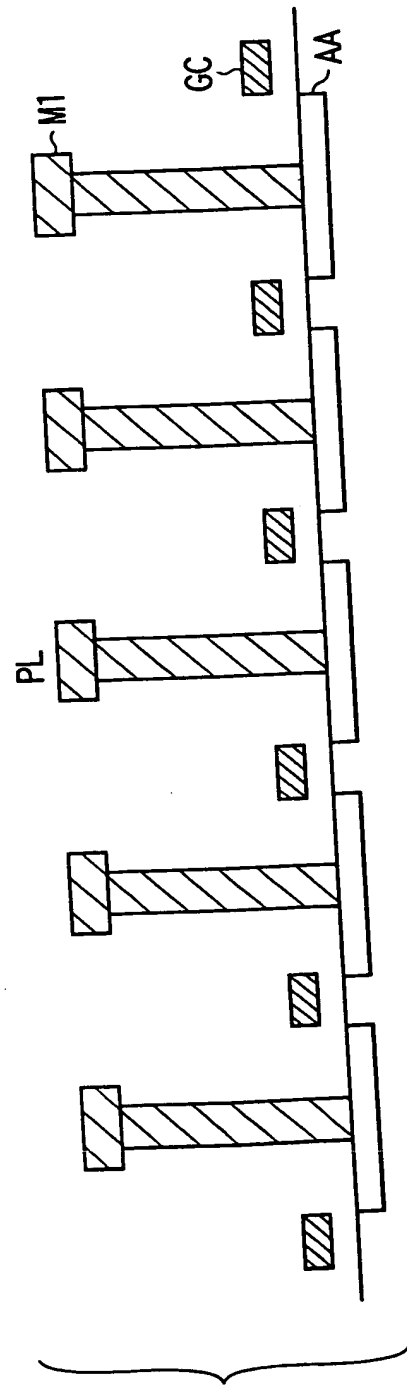


FIG. 212B

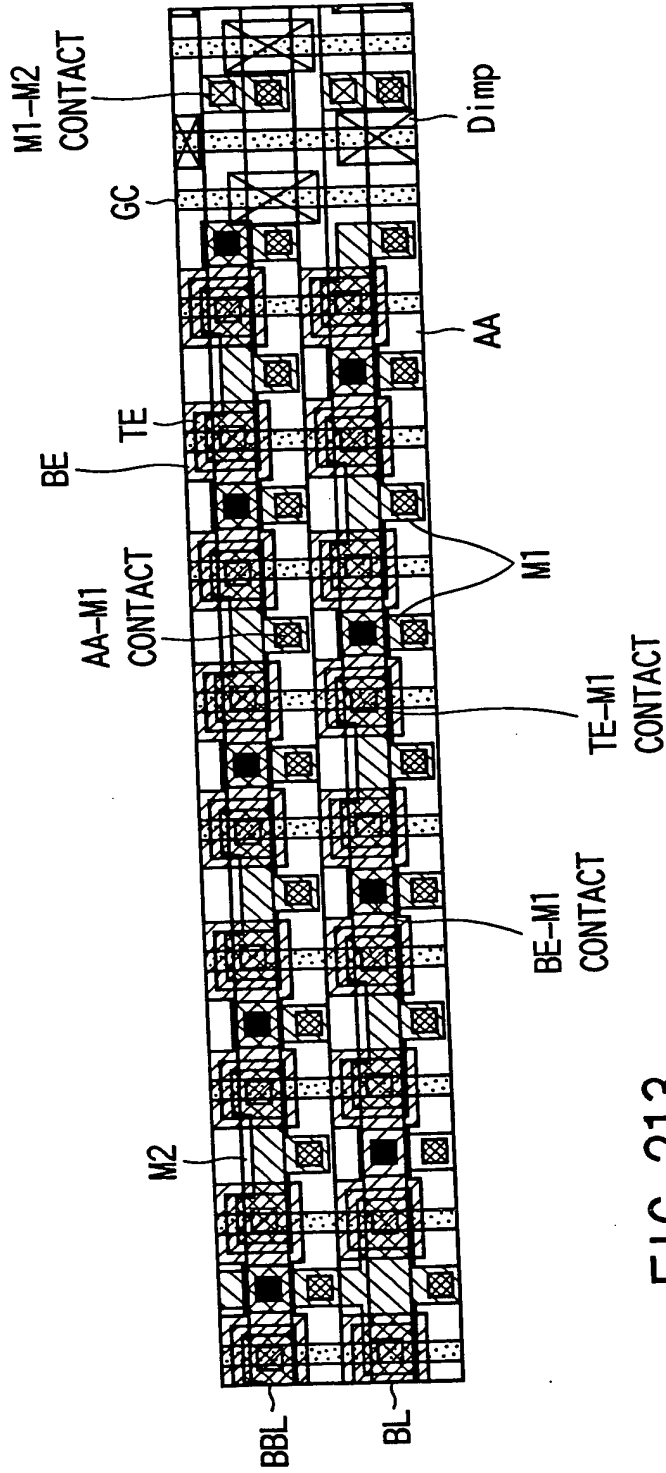


FIG. 213

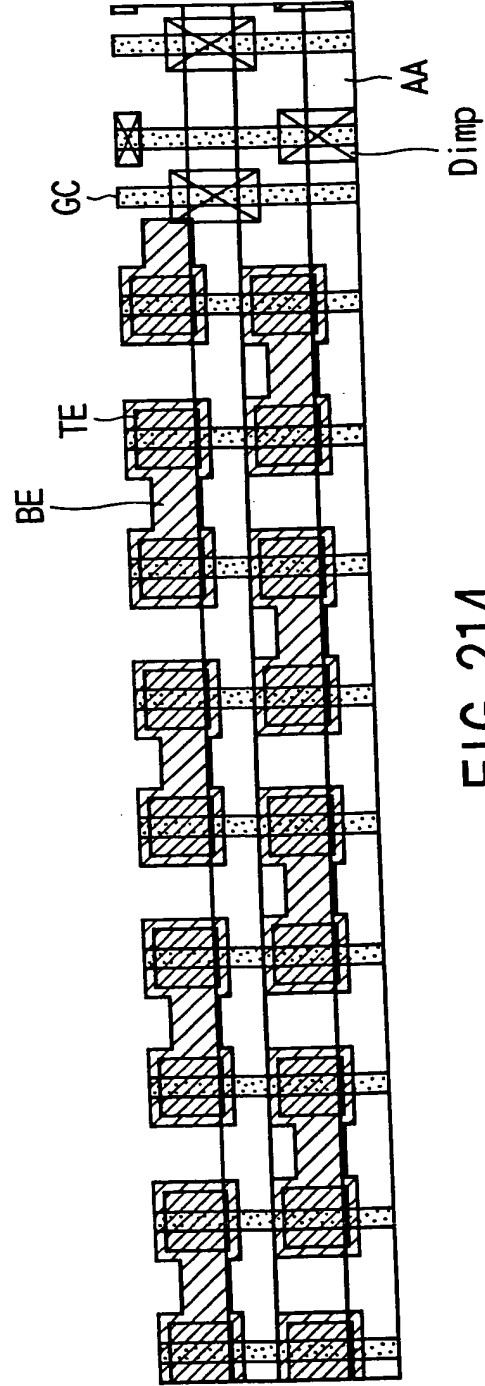


FIG. 214

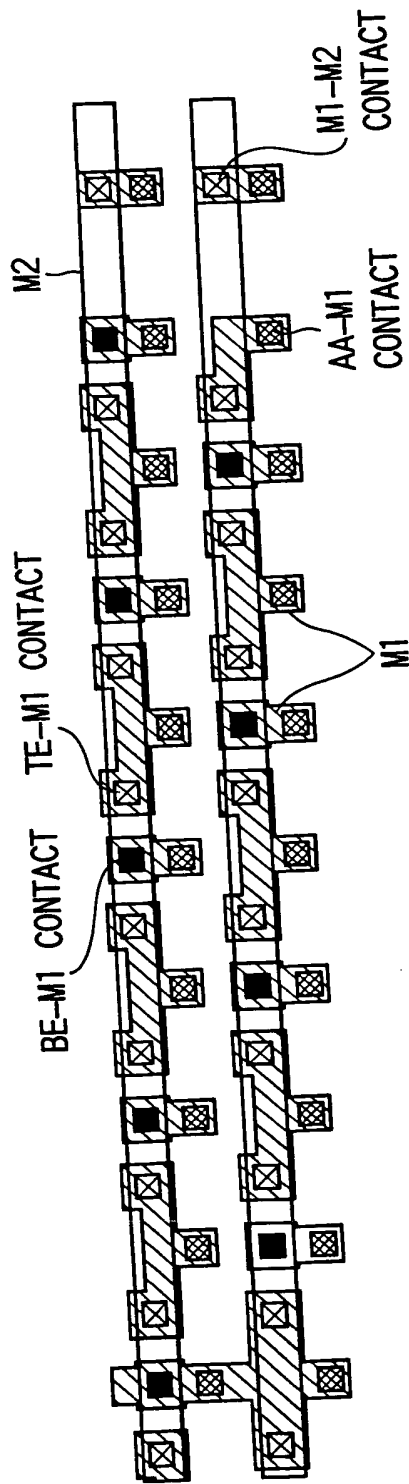


FIG. 215

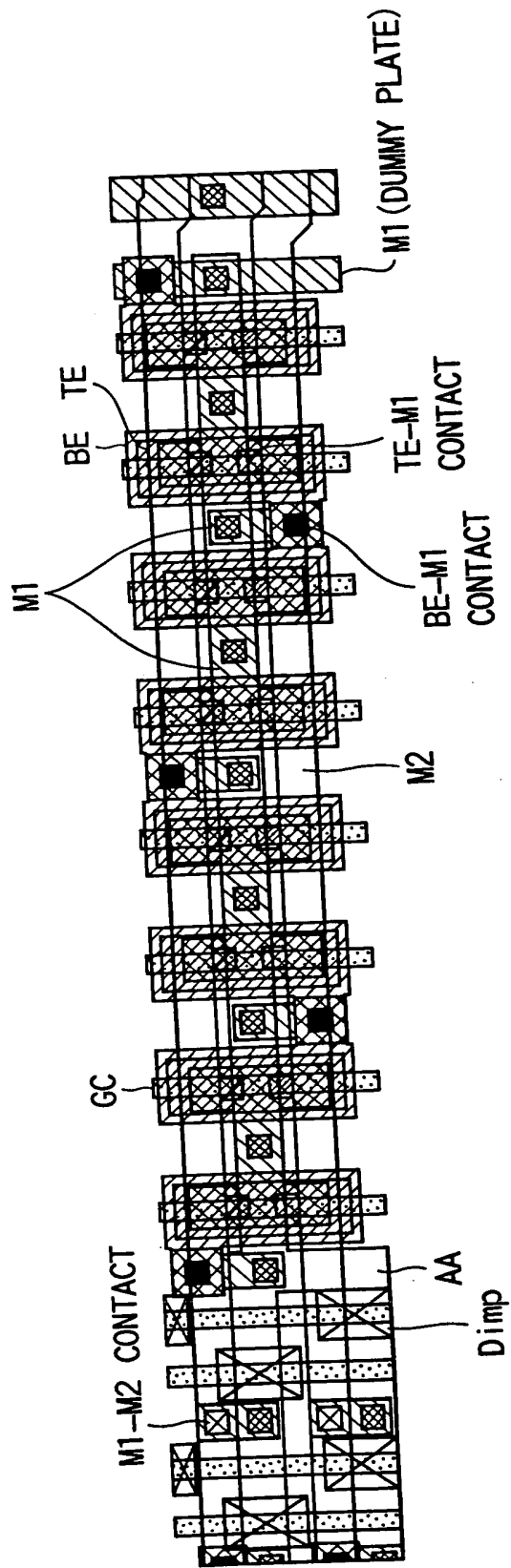


FIG. 216

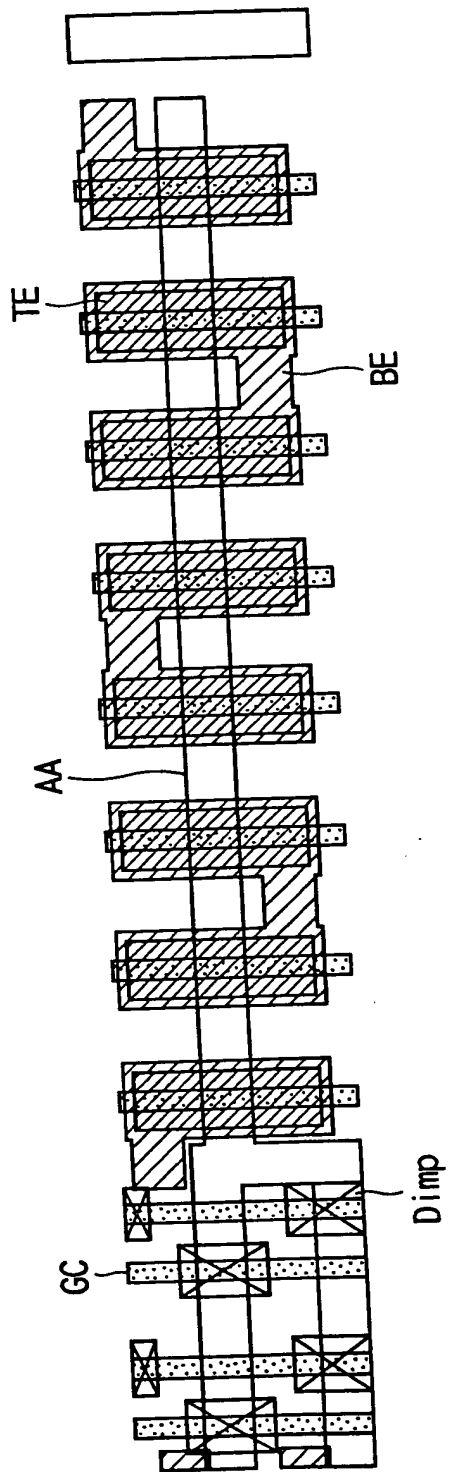


FIG. 217

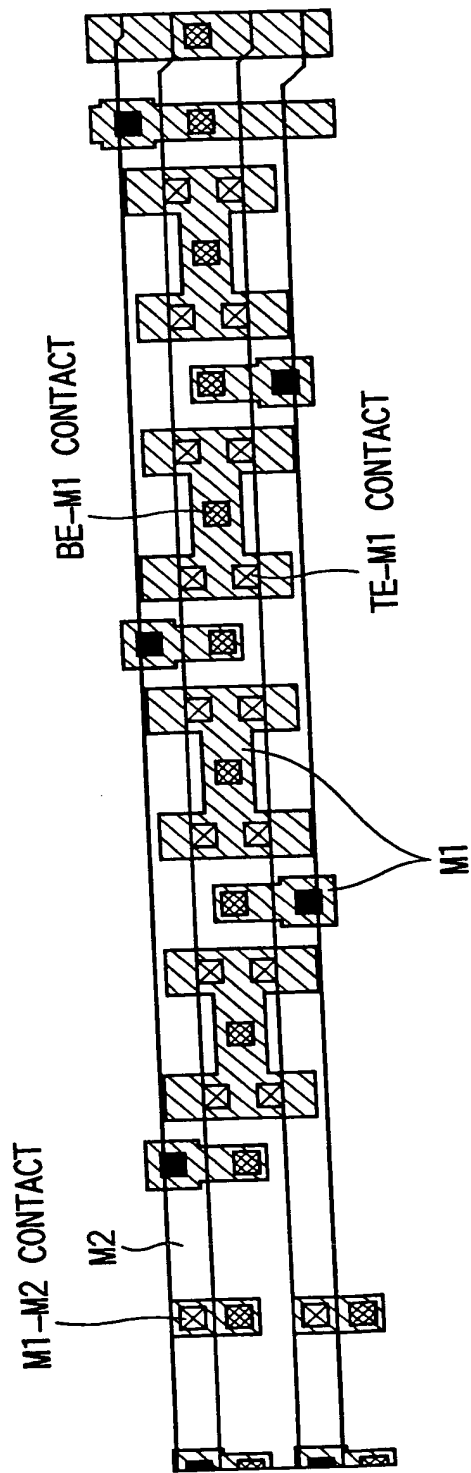


FIG. 218

FIG. 220 is a cross-sectional view of a semiconductor device. It shows a series of vertical structures (BE) connected by horizontal lines (GC) and a top layer (AA). The structures are separated by a material (TE).

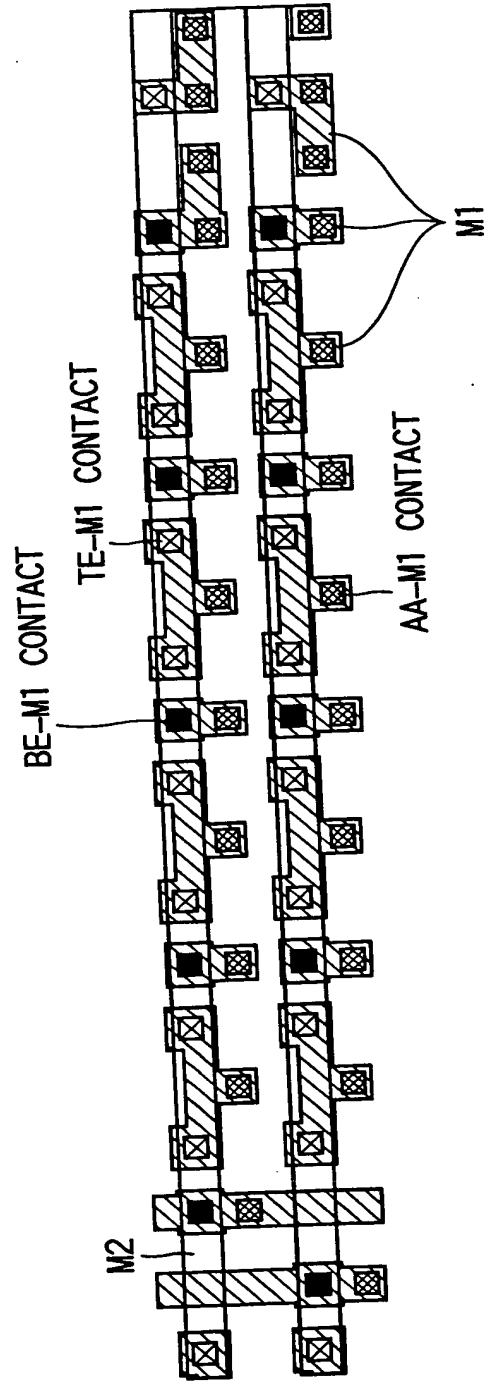


FIG. 221

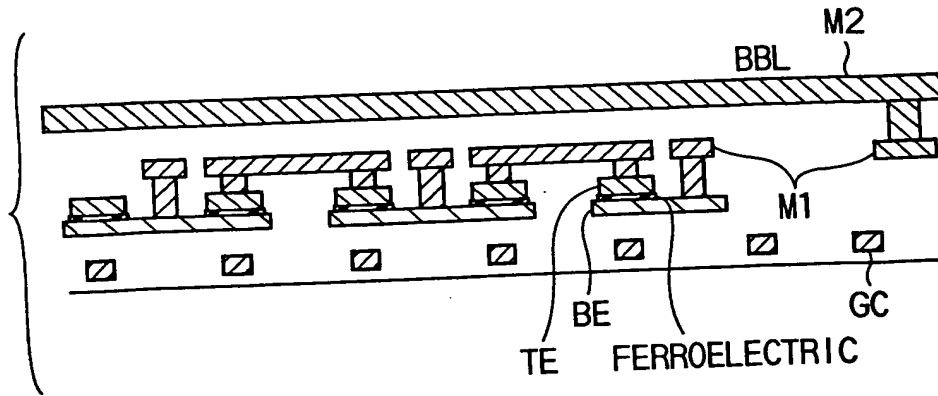


FIG. 222A

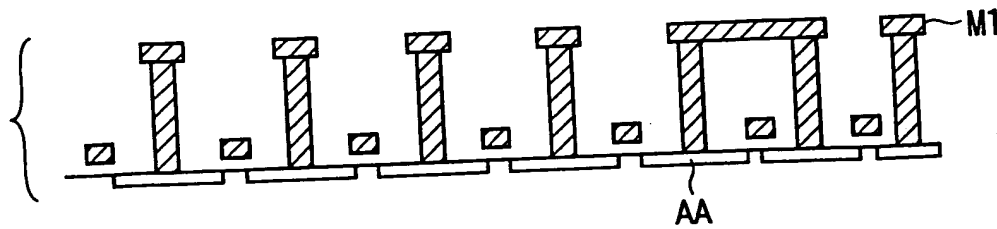


FIG. 222B

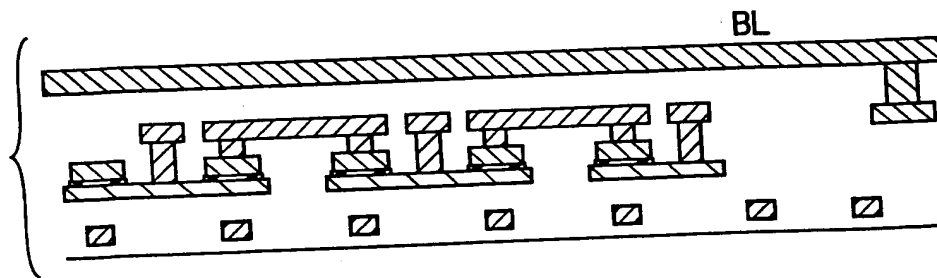


FIG. 222C

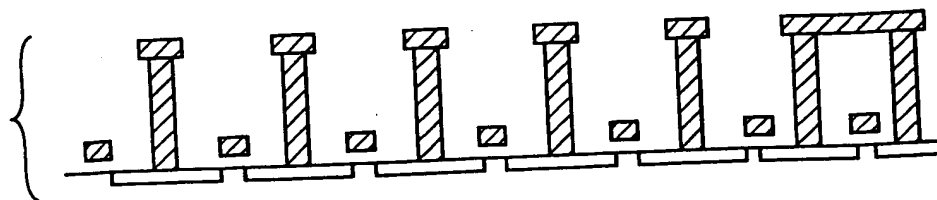


FIG. 222D

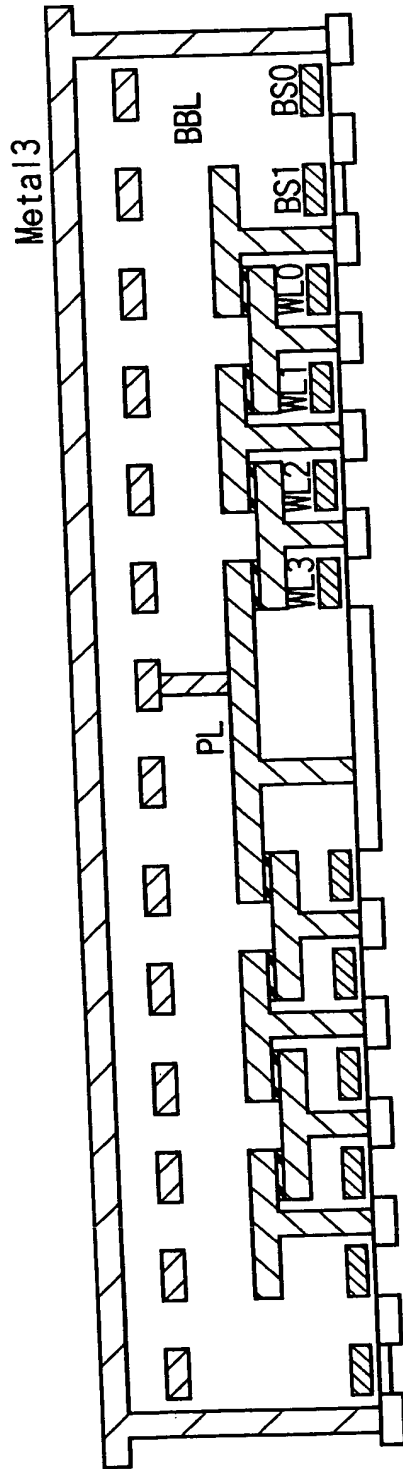


FIG. 223A

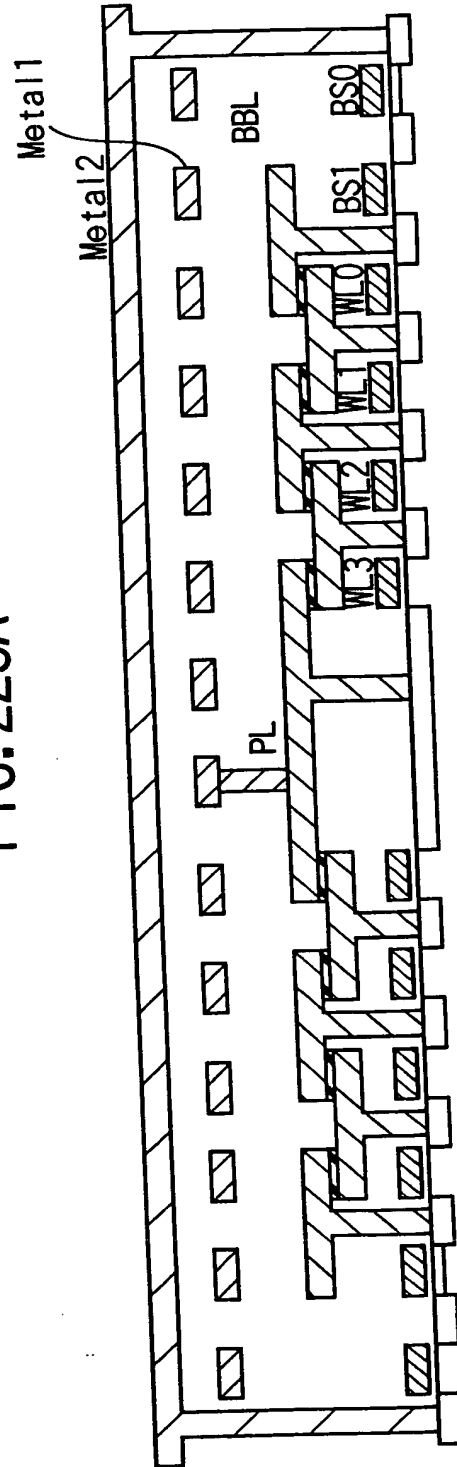


FIG. 223B

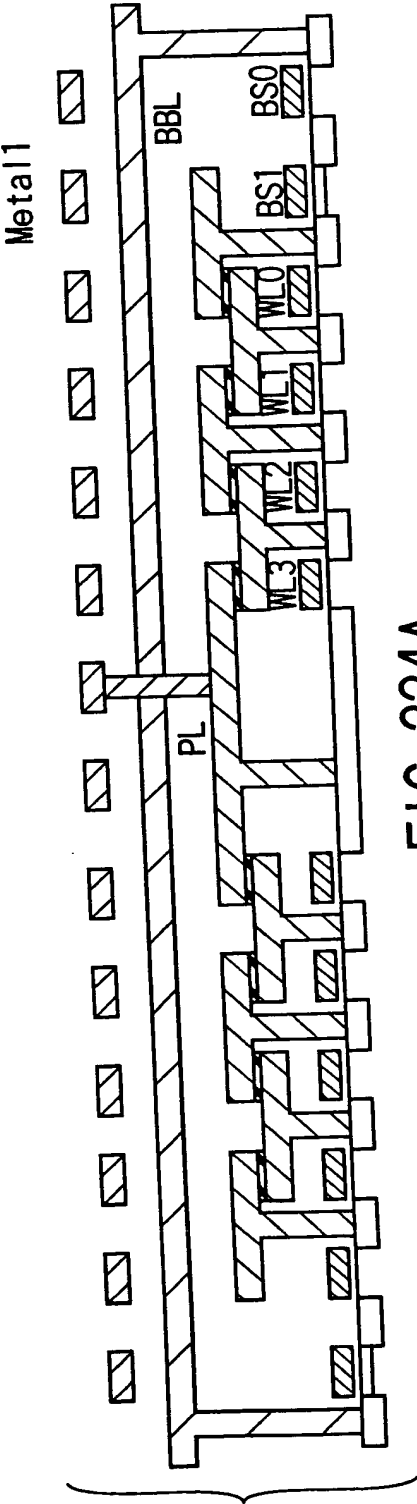


FIG. 224A

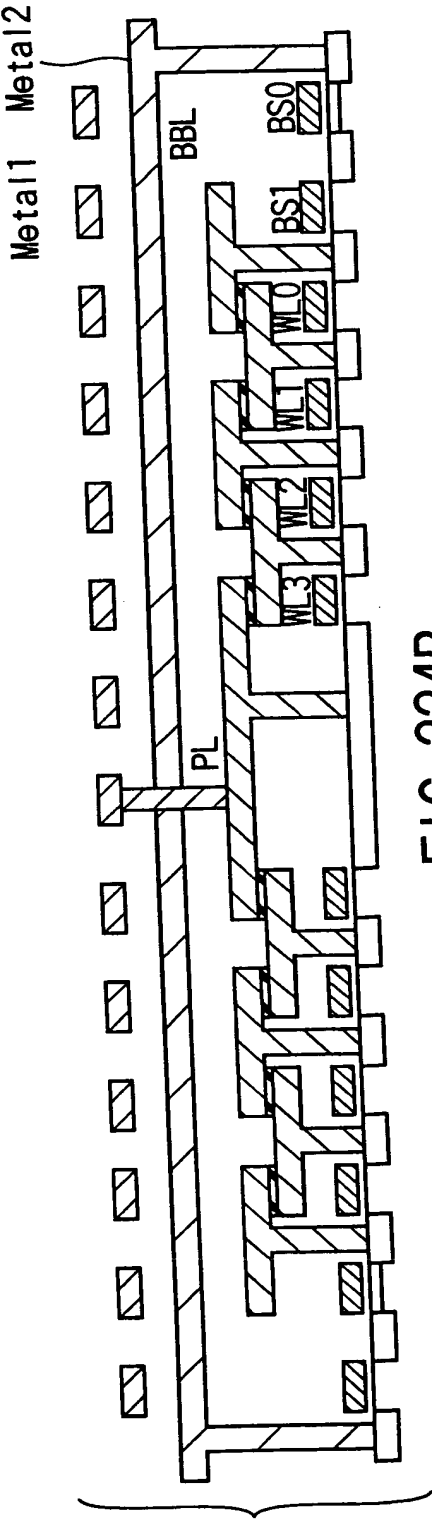


FIG. 224B

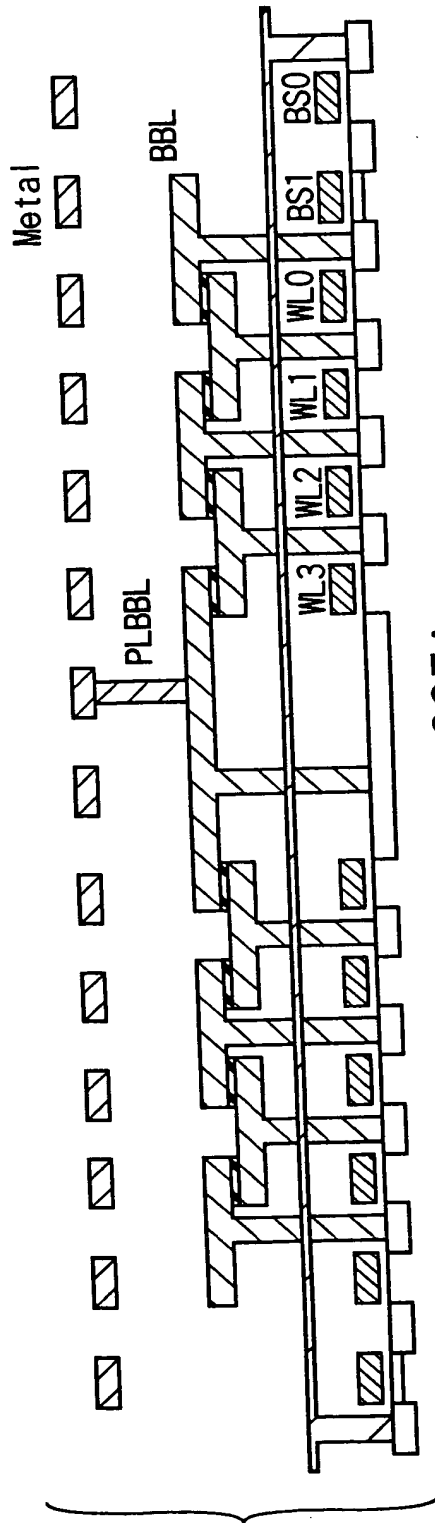


FIG. 225A

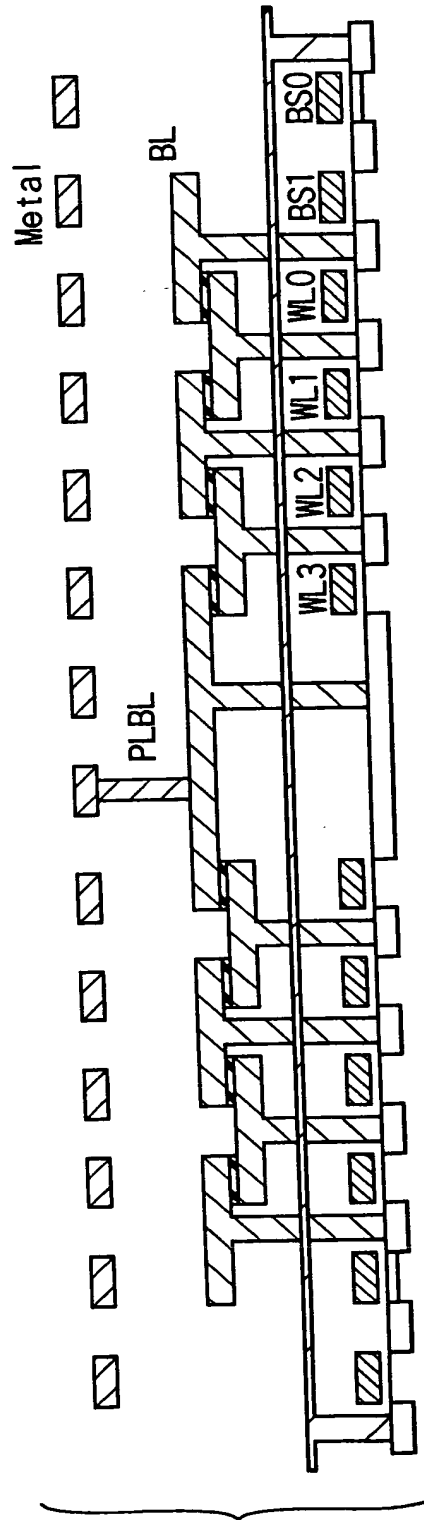


FIG. 225B

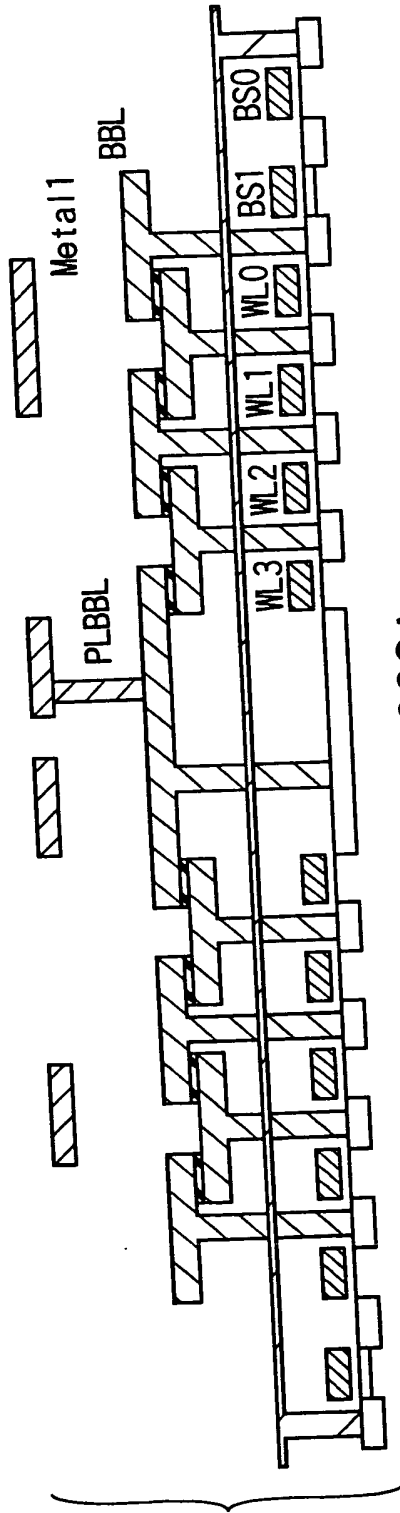


FIG. 226A

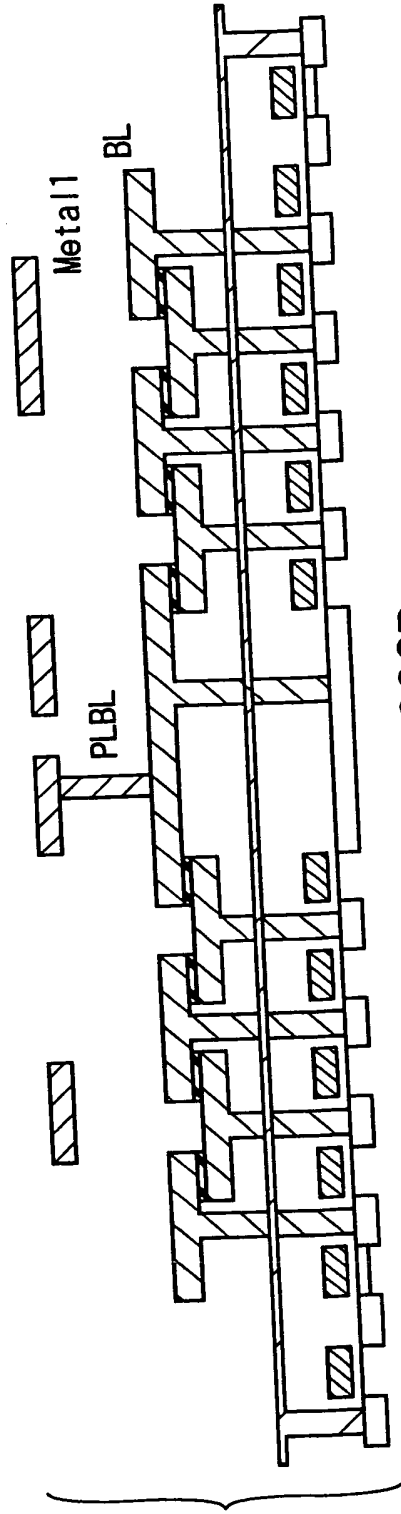
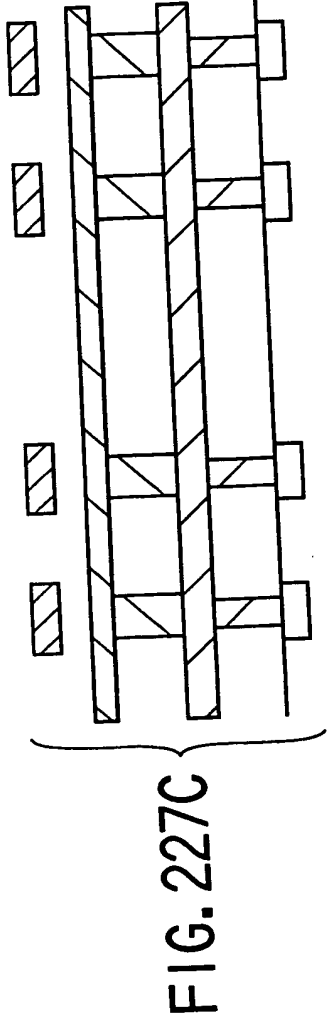
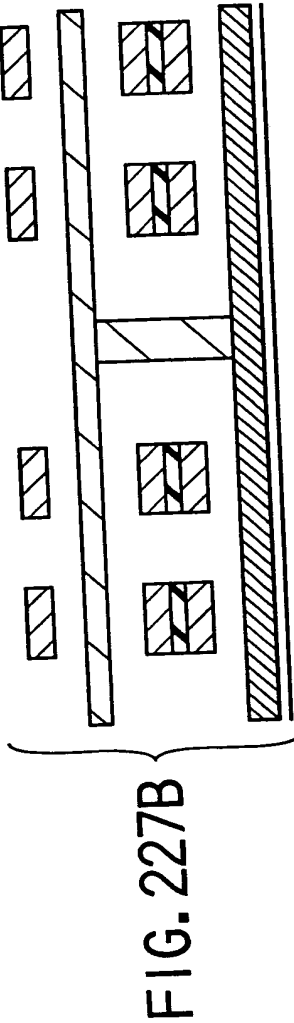
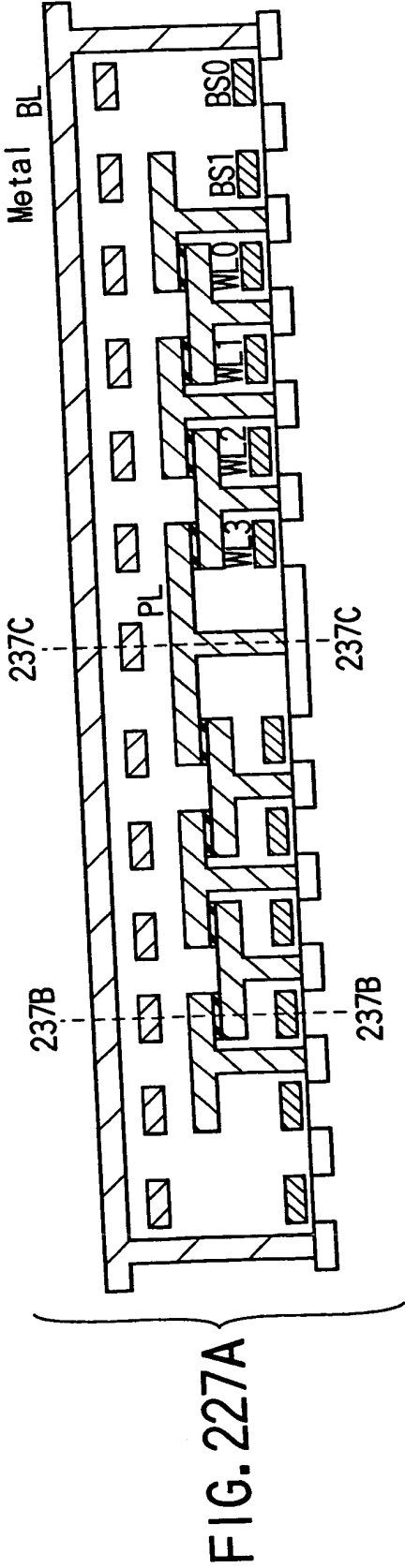
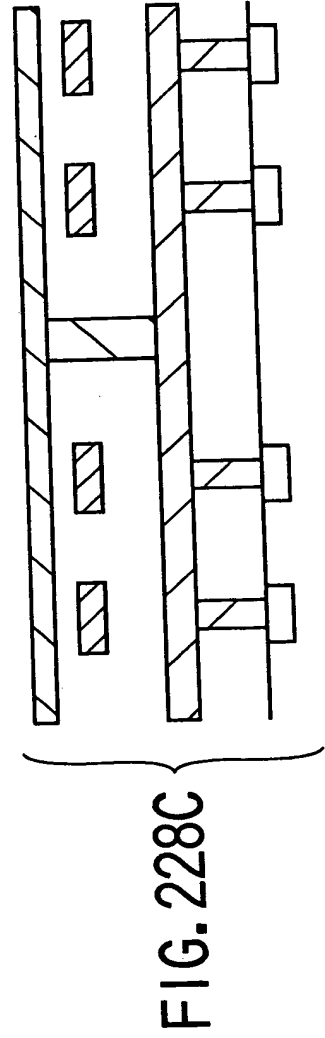
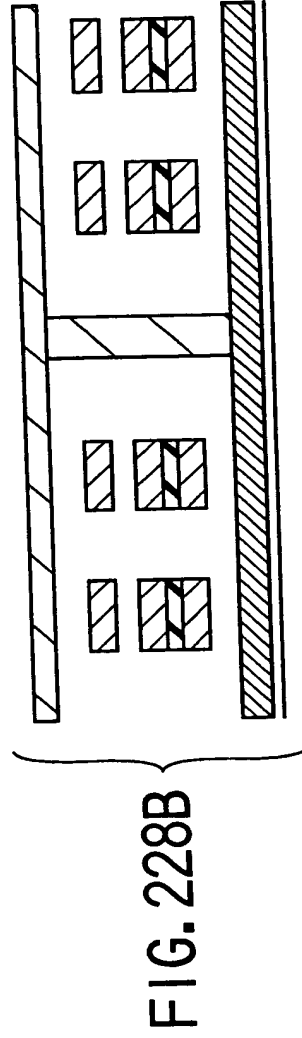
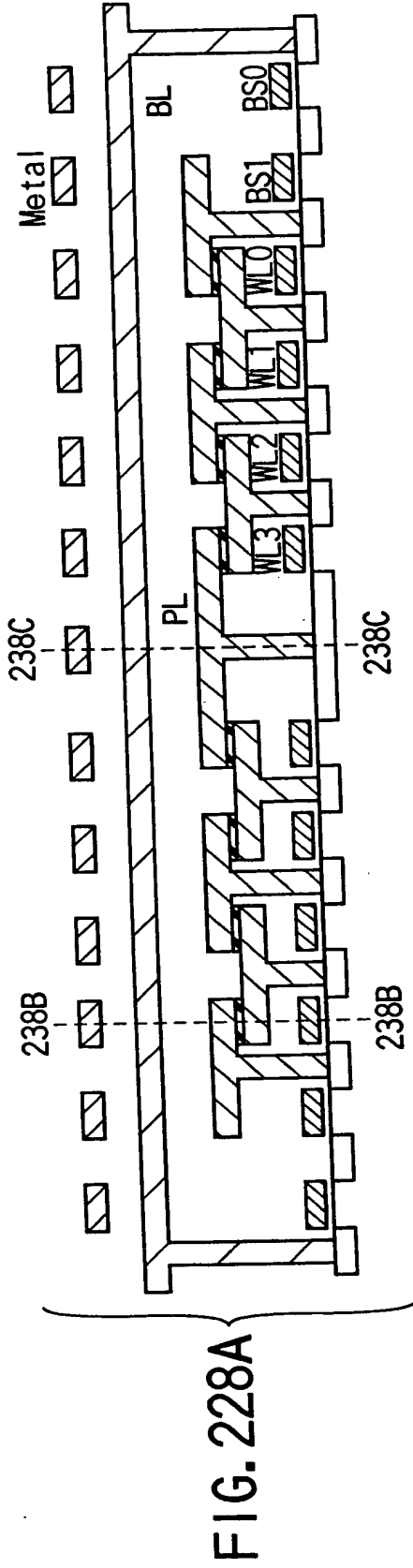
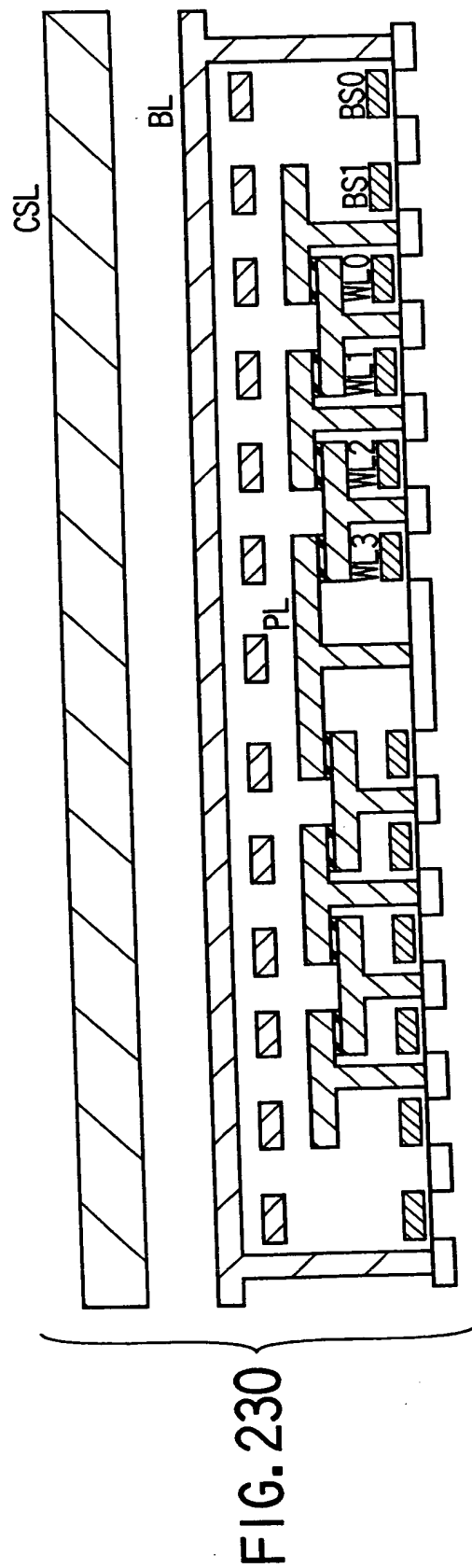
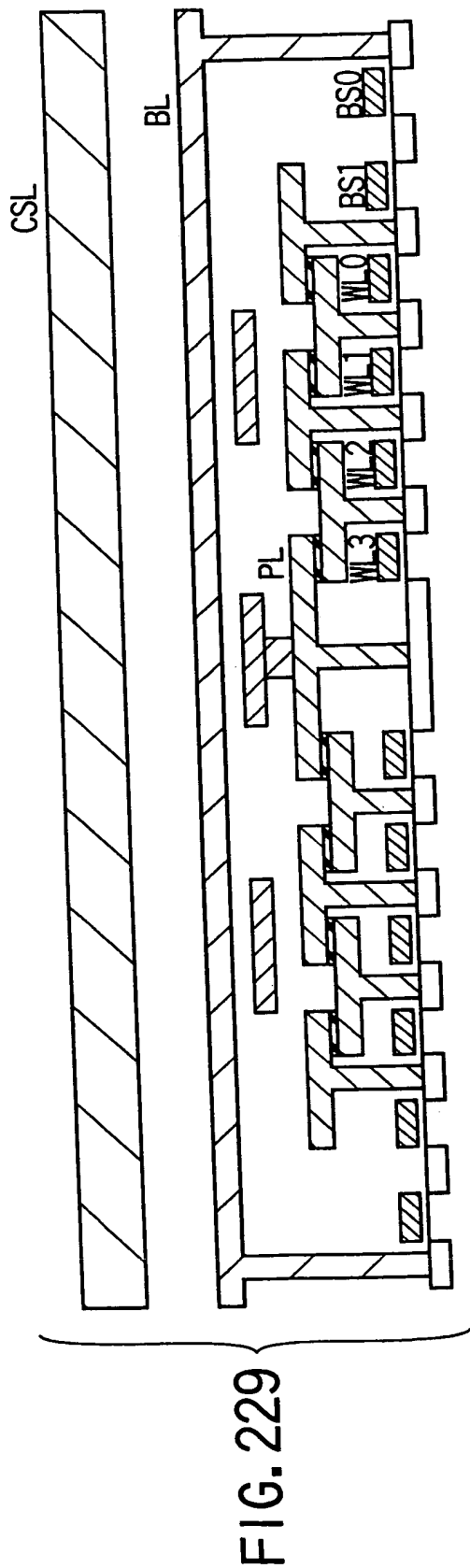


FIG. 226B







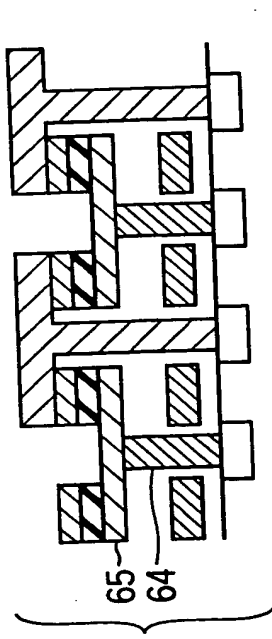


FIG. 231A

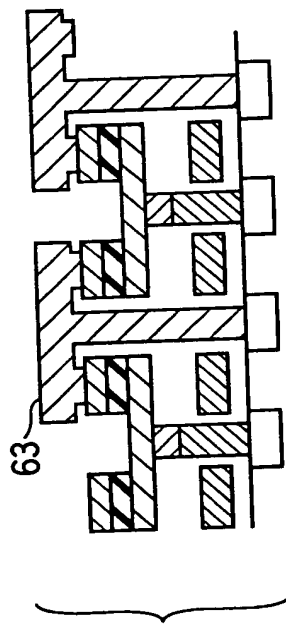


FIG. 231B

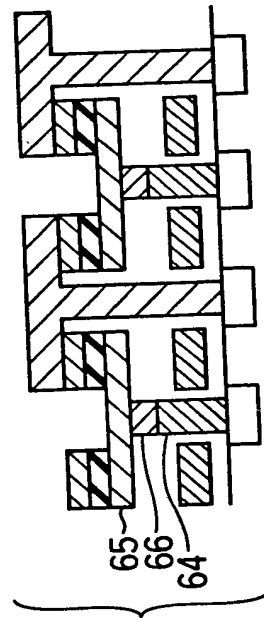


FIG. 231C

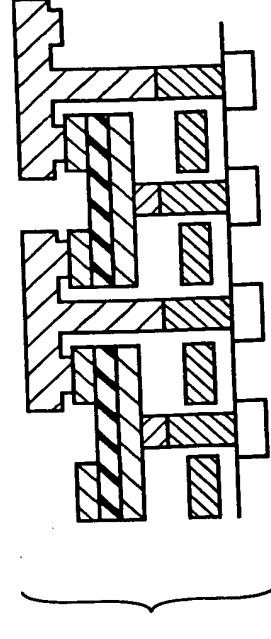


FIG. 231D

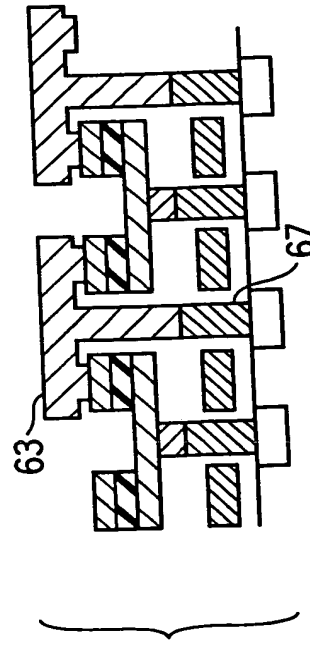


FIG. 231E

FIG. 231F

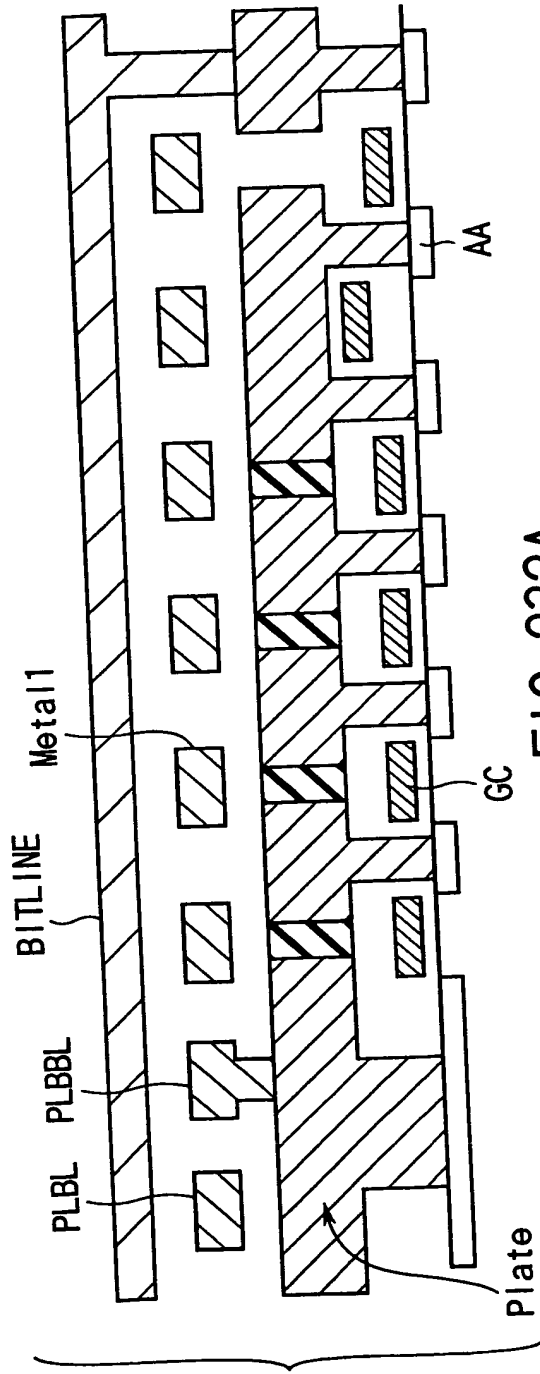


FIG. 232A

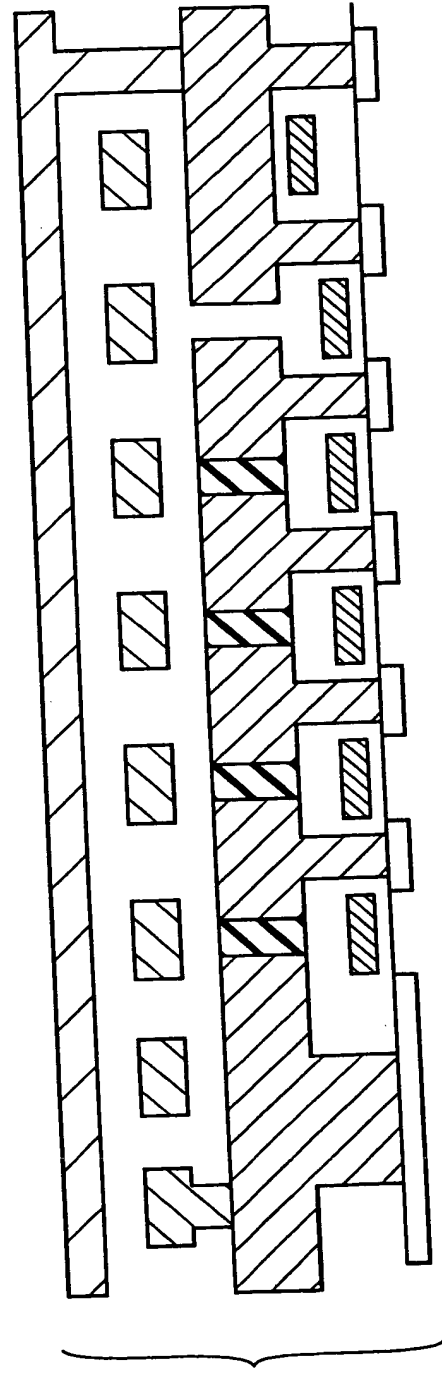


FIG. 232B

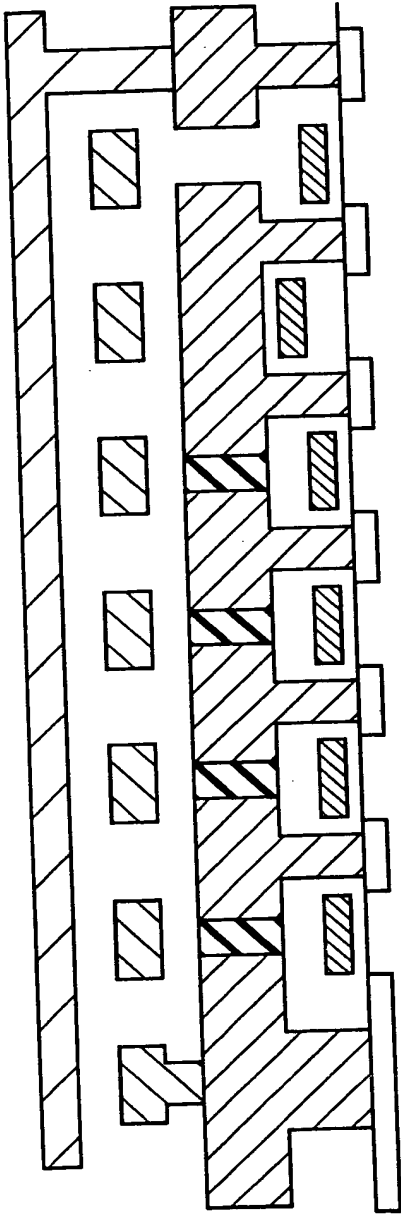


FIG. 232C

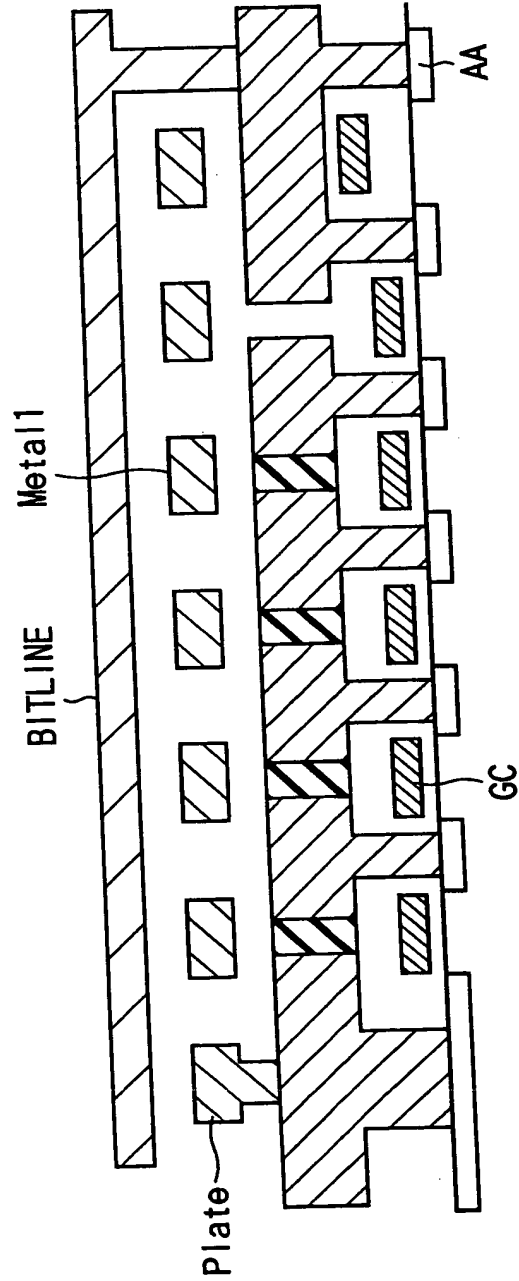


FIG. 232D

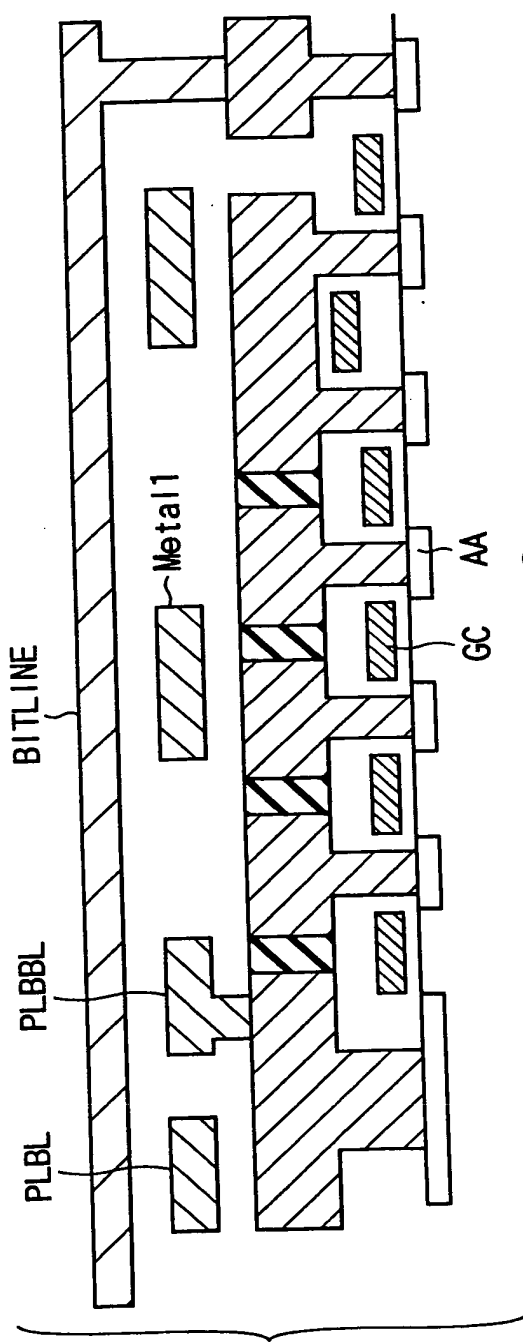


FIG. 232E

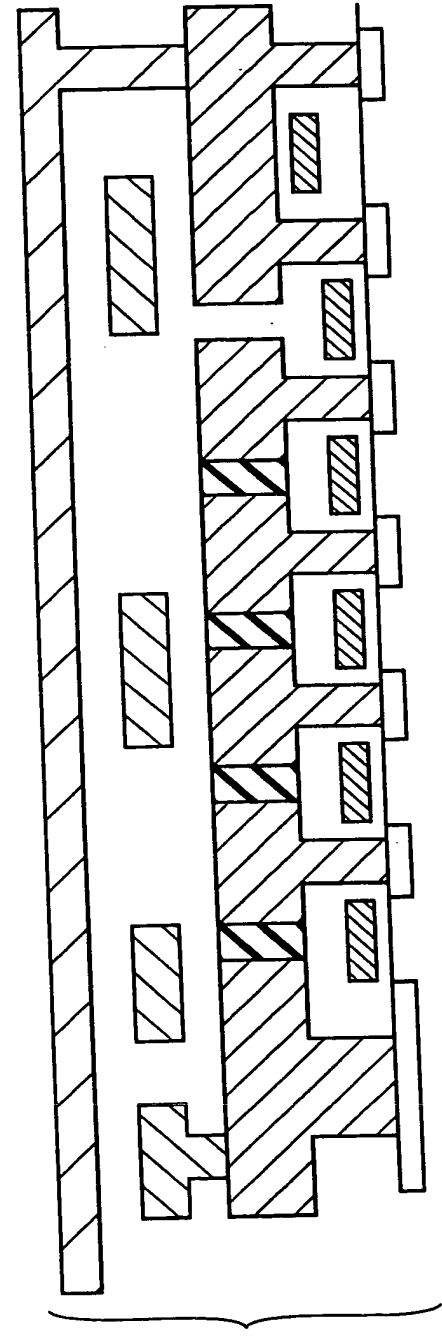


FIG. 232F

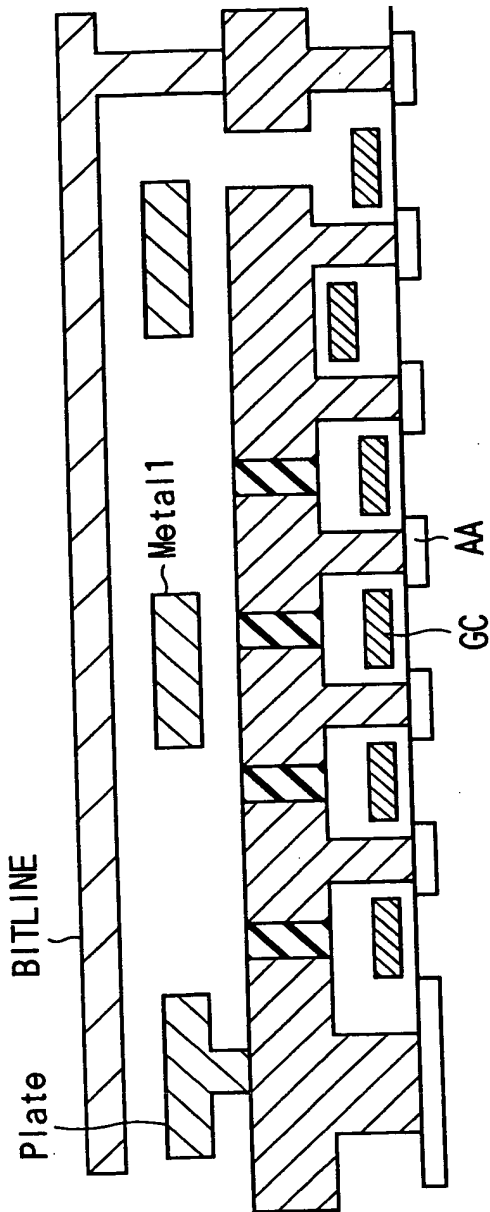


FIG. 232G

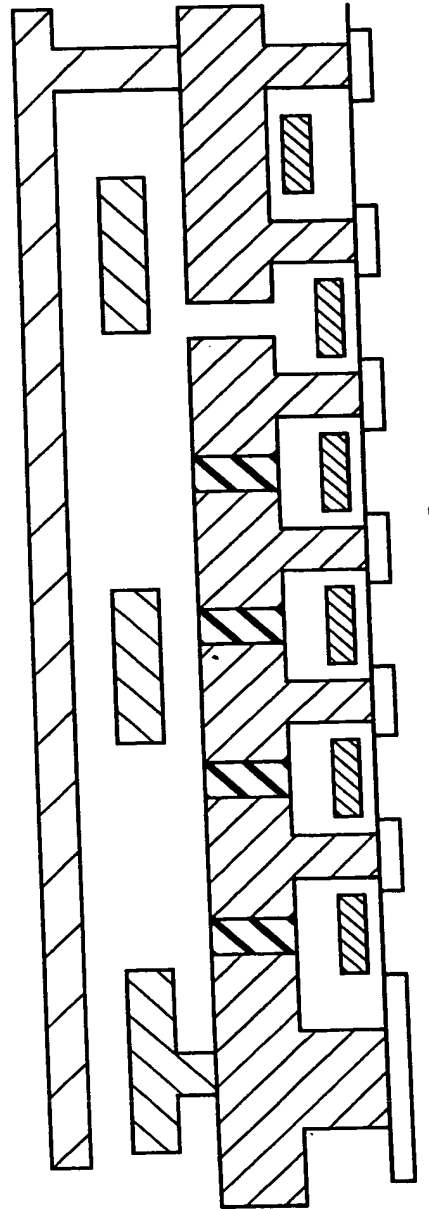


FIG. 232H

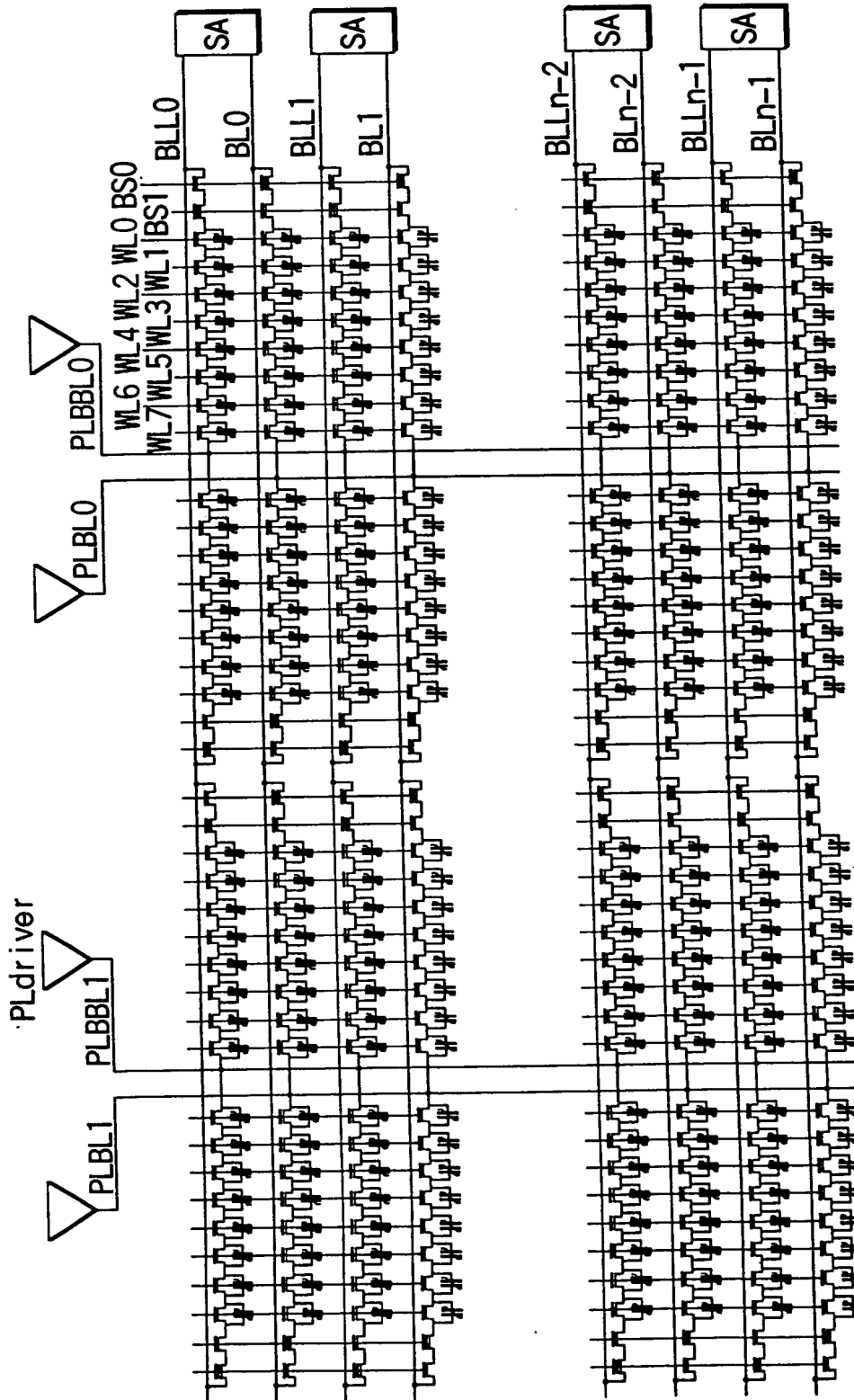


FIG. 233

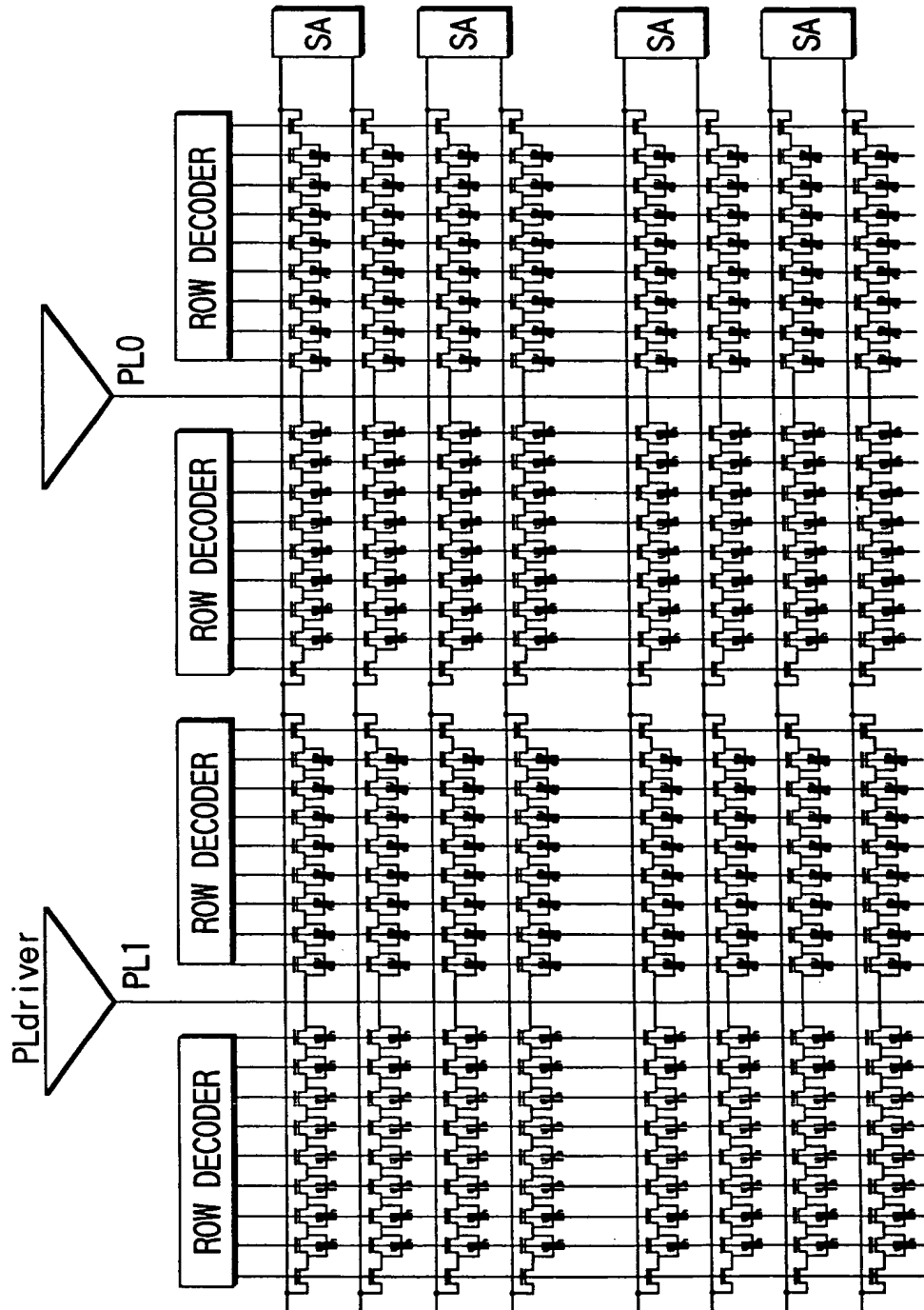


FIG. 234

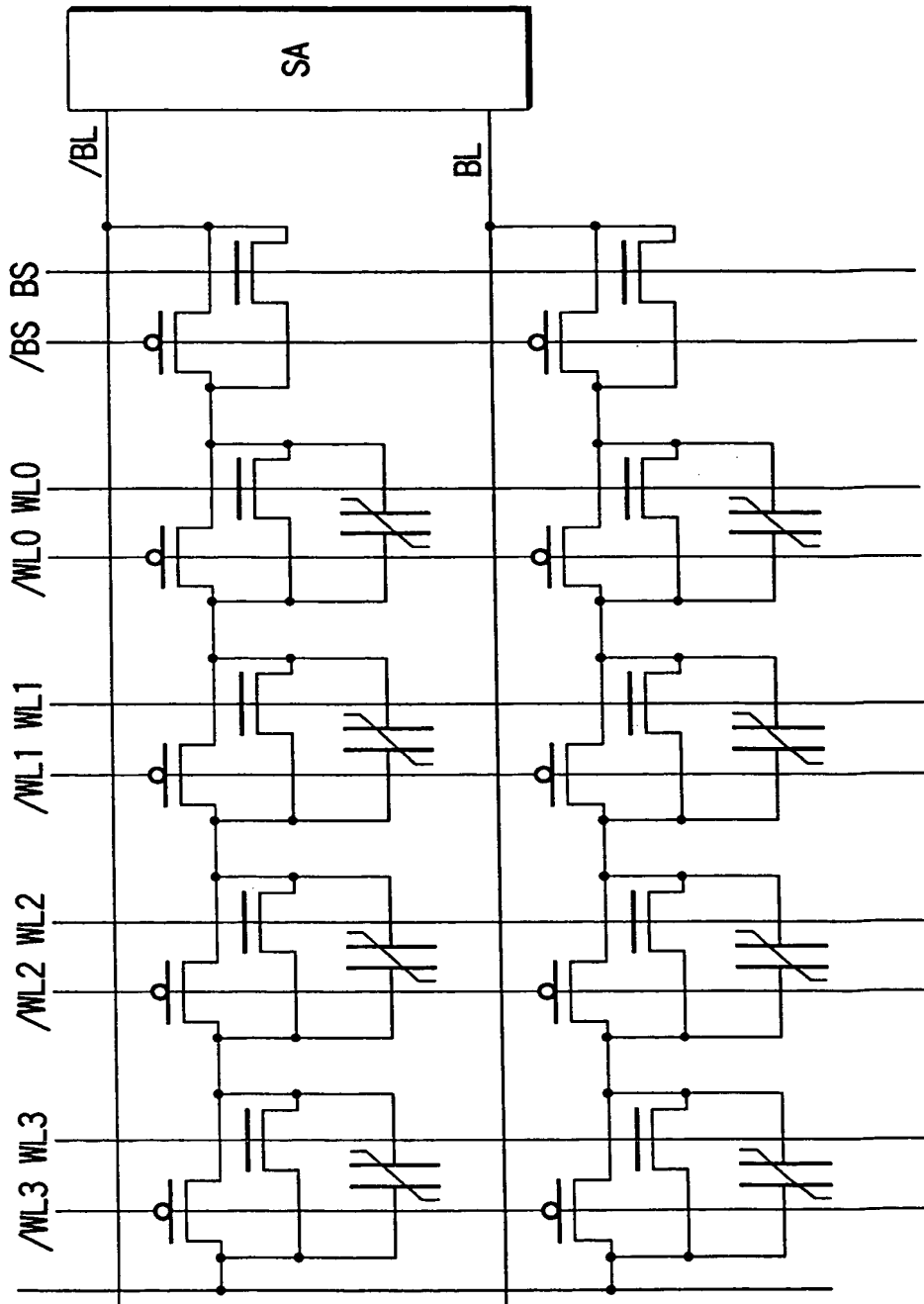


FIG. 235

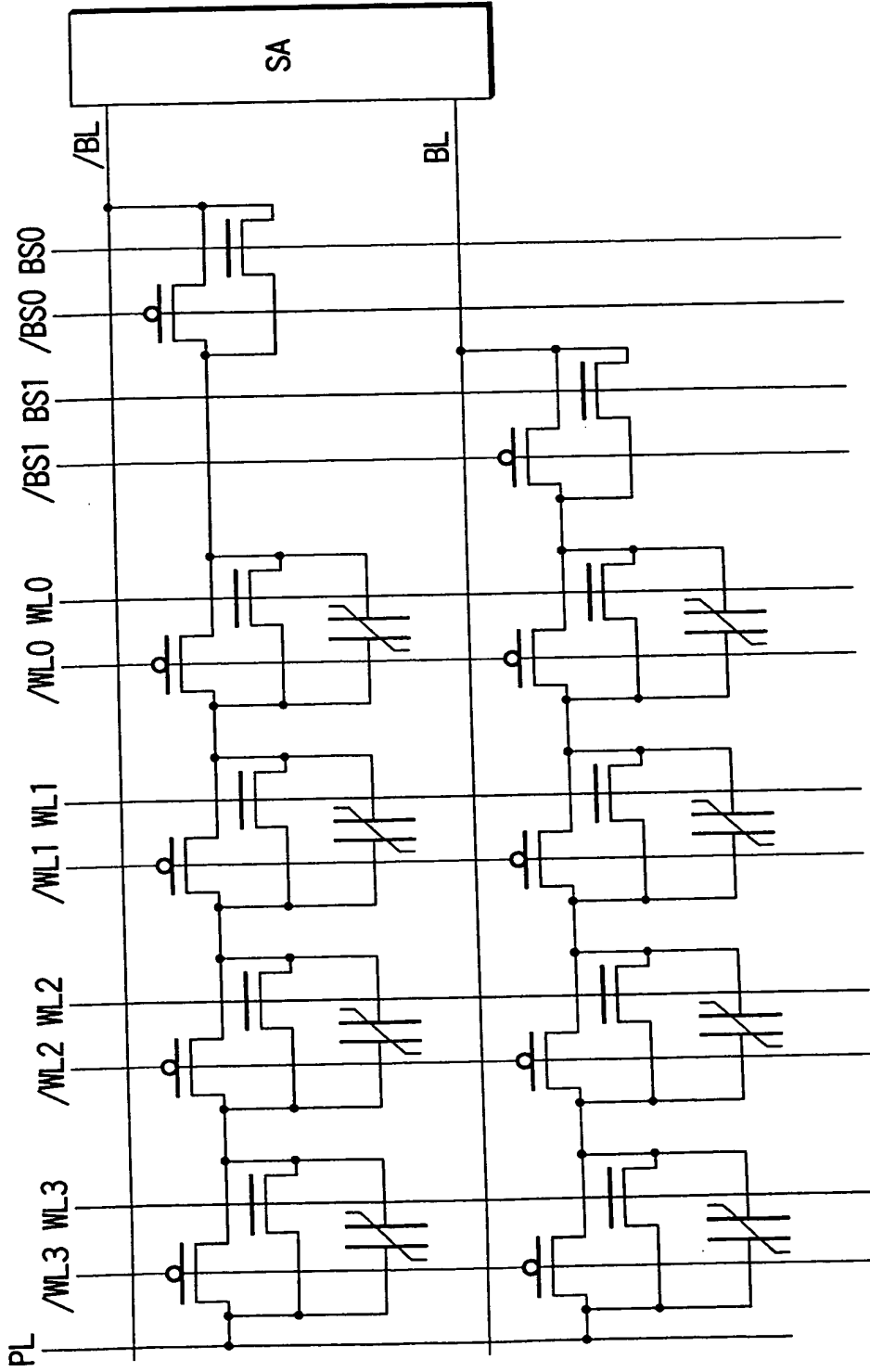


FIG. 236

